THE IRON TRADE REVIEW

VOLUME XXX. CLEVELAND, O. JULY 15, 1897. CHICAGO, ILL. NUMBER 2

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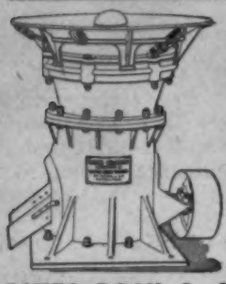

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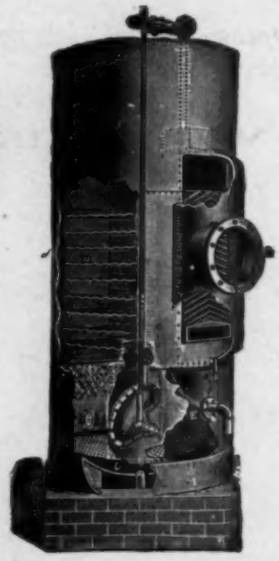

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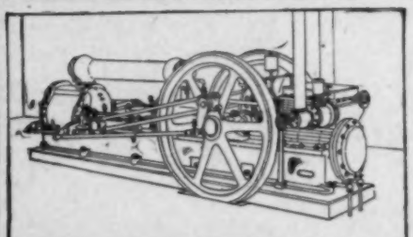

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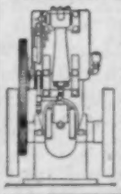

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THE IRON TRADE REVIEW

VOLUME XXX. CLEVELAND, O. JULY 15. 1897. CHICAGO, ILL. NUMBER 28

THE WEEK IN IRON CIRCLES.

THE MARKET AT LARGE.

Neither the wage shut-down nor the coal strike at bituminous mines has as yet had any decided effect upon the iron market. Coke, natural gas and anthracite are still available in usual supply, while a good many works can turn to fuel oil, if need be. Soft coal has not yet become so scarce that boilers cannot be fired and gas producers kept going, except in a few cases. Yet it is evident that concerns supplied from the districts in which the strike is most complete will soon exhaust their fuel, and if West Virginia miners should go out in any considerable numbers, the embargo would quickly become serious to the iron trade. Meantime, the idleness of Central Western bar iron and sheet mills eliminates one considerable coal-using interest. There has been some scale-signing the past week, largely by tin plate mills, in ratification of the settlement reached 10 days ago. Some of the smaller merchant iron and sheet mills have signed conditionally. The sheet scale is likely to be settled within another week. Among bar mills the shut-down is more likely to run through July. Prices have made no change for the better in the week, except that galvanized sheets are higher and black sheets also are more firmly held. The demand for both, with the fortnight's idleness of union mills, has quite filled up the books of such mills as are running. In general the situation as to volume and prices is not particularly promising. Little is expected of July and August, but confidence is abundant that with a new tariff law in force, and Western farmers and the railroads flush from plentiful harvests, the fall months will bring a larger tonnage to iron and steel mills. There is scant encouragement, however, for those who have been predicting an advance in prices. The past two or three weeks have seen the gradual dissipation of the slight improvement in pig iron noted in the latter part of June. Bessemer iron in particular is weak. Central Western steel works seem to have covered their needs into early fall, and meantime some low offers have been made by sellers. It is reported that $9, valley furnace, has been shaded, and $9.30 to $9.50 is the range of Pittsburg quotations. Steel billets are also weaker; while $14, Pittsburg, is quoted there are few sales. The situation as to Southern pig iron is unchanged. Quotations are held by some sellers at the advanced basis noted two weeks ago, but these prices are not paid, except on the soft irons which continue scarce. In the Chicago district, where considerable sales were made in the second half of June, the situation is better from the seller's standpoint than elsewhere. Local irons are increasingly strong competitors of Southern brands, and this is true of soft irons, also as our Chicago report shows. Finished material markets have shown the usual midsummer dullness inthe past week. Some good structural orders are to be placed at Chicago, but with agricultural buying largely out of the way, merchant iron and steel are quiet, with no prospect of large demand until the railroads and car works are heard from. The Amalgamated Association has saved to unionism the largest Pittsburg concern in which it has a footing, by practically bringing its steel scale down to the demands of the company.

THE CLEVELAND DISTRICT.

The vessel and dock problem still controls the ore situation. There is presumably much ore-buying yet to be done, but furnacemen whose stacks are idle want to be better assured as to the amount of ore they will need, for with many the date of resumption is still indefinite. As predicted a week ago, vessels are beginning to tie up and the movement will extend if dock conditions do not change. A second washout on Minnesota mining roads, and the flooding of some of the open-pit mines have cut off the ore supply at Duluth and caused several days' delay to vessels. At Lake Erie docks the blockade has kept up, though, since the coal strike began, cars have been somewhat more plentiful. With no coal up and no assurance of ore when the head of the lake was reached, boats have had a hard time, the past week, and so long as the coal strike lasts many will lie idle. July promises an unusually light movement of ore; and with ore, coal and grain shipments crowded into three months there is now some prospect of the fall advance in rates for which vessel men have hoped. Considerable short season tonnage in ore will expire before the amount originally figured on is moved, and wild ore tonnage in September is likely to have a value quite a little in advance of any season figures.

Pig Iron. No transactions in Bessemer iron through local offices are reported in the past week. The valley quotation is nominally $9, and furnaces are naming higher figures on forward business. Under present conditions no additional furnaces will be started up except those with connected mills whose preparations are already under way. Foundry irons have had an exceedingly quiet week. Some sellers have been able to hold $9.25, valley furnace, as minimum for No. 2; others have sold at $9, and this figure has been passed in the slide downward. Forge iron is dull, with the mills idle. The quotation is nominally $8.10, valley. Coke can be had at $1.25, ovens. Connellsville production went up to 110,000 tons for the first week in July. No interruption to operations there will come from the strike; on the contrary, shipments of Connellsville coal are probable, if the strike elsewhere becomes serious. We quote iron, f.o.b. Cleveland:

Bessemer	$ 9 65	Valley Scotch No. 1	$10 40@10 65
No. 1 Strong Foundry	10 25@10 65	Valley Scotch No. 2	10 00@10 15
No. 2 Strong Foundry	9 65@10 15	Gray Forge	8 65@ 8 75
No. 3 Foundry	9 25@ 9 50	Lake Superior Charcoal	12 75@13 00

Finished Material. The week has brought little new business. In bar iron, even the small orders going have already made ragged edges in the moderate store stocks carried. Mills are taking their time about repairs and unless a sudden concession of a $4 puddling rate comes, the dead-lock may run into August. One local sheet mill has shut down from lack of fuel and a wire nail plant is crippled from the same cause. Galvanized sheets are in good demand and discounts on good sized orders are now 80 and 7½, as against 80 and 10 and 5 recently. The few mills running are well supplied with orders. Black sheets are now held $1 a ton higher by some sellers. More is doing in old material than might be expected with mills idle. We quote No. 1 railroad wrought scrap at $9 to $9.50; mill scrap, $7; old car wheels, $9.75; old steel rails, $9 to $9.50; old iron rails, $11.

CHICAGO.

OFFICE OF *The Iron Trade Review*, 1142 MONADNOCK BLOCK, July 14

Very little of importance has come up in the last week. The most important news is that concerning the strikes in the coal mines of the country, and there has been considerable speculation as to their effect upon the business situation and the iron market. The local iron and steel interests have little fear of trouble from lack of fuel, as most concerns here are equipped to use fuel oil as well as coal. The Joliet plant of the Illinois Steel Co. went on to fuel oil last week, in order to save coal for the other plants. The South Works are prepared for oil burning, but it is not thought it will be necessary to use that equipment unless the shortage of coal should be much greater than at present. A large number of the other manufacturing establishments, besides the iron and steel manufacturing plants, are fixed for oil burning, and this fact will insure a longer supply of coal than would otherwise be the case, even if all the sources of supply are stopped. There has been no further trouble with the employes of any of the mills in this district, the only one that is shut down because of wage differences being the Milwaukee works of the Illinois Steel Co. No attempt has been made to start these works since the strike. Business in the week has been light, very few sales of importance having been made in any branch of the trade. Prices are about as quoted last week, and in almost every case are very firm.

PIG IRON.—The demand has been light, with sales smaller than for several weeks previous. There are still some large buyers who have not supplied their wants, but these do not seem to be in a hurry to place orders. These and others, who take smaller lots, will keep the market alive for the next few weeks, but it is not expected that there will be anything like brisk business for some time to come. Both Northern and Southern furnaces are very firm, and no cutting of prices is being done. In fact, it is not necessary, as buyers appear to be willing to pay the prices asked. It is probable that one or two furnaces at Milwaukee will be put in blast shortly on foundry iron, but nothing definite has been announced. Southern soft irons have been and are very scarce and command a relatively higher price than the foundry grades. The soft iron made by the Illinois Steel Co.'s furaces at Milwaukee is finding its way into the market, and a number of buyers in this market have ordered sample lots. This iron is offered as a substitute for Southern soft irons, and experiments are now being made that will furnish definite data within the next few weeks. If the claims of the makers are well established, the field for Southern iron in this market will be more limited than ever. The Northern furnaces have been making prices on foundry grades for some time past with which the Southern furnaces could not or would not compete, and the result has been that a large tonnage of iron which has heretofore gone to the Southern furnaces in this territory has been given to the North. With a large number of buyers the choice of Northern or Southern iron is largely a matter of price, and future business promises to depend more than ever upon the relative quotations on the irons. If the export business of the Southern furnaces continues, it will enable them to keep their prices up, within limits, even though the Northern market should be further curtailed. We continue to quote:

Lake Sup. Charcoal	$13 00@13 25	Southern No. 1 Soft	$10 50@11 00
Local Coke Fdy. No. 1	10 50@10 75	Southern No. 2 Soft	10 00@10 50
Local Coke Fdy. No. 2	10 25@10 50	South'n Silveries	10 25@10 50
Local Coke Fdy. No. 3	10 00@10 25	Jackson Co. Silveries	13 00@15 00
Local Scotch Fdy. No. 1	10 50@10 75	Ohio Silveries	13 00@15 00
Local Scotch Fdy. No. 2	10 25@10 50	Ohio Strong Softeners	12 00@12 25
Local Scotch Fdy. No. 3	10 00@10 25	Alabama Car Wheel	15 50@16 00
South'n Coke No. 1	10 50@11 00	Malleable Bessemer	10 75@11 00
South'n Coke No. 2	10 00@10 25	Coke Bessemer	11 50@12 00
South'n Coke No. 3	9 75@10 00		

BARS.—Very little business has been done in the past week. The demand has been limited and mills are not anxious to accept any very large orders at the present time. Prices are unchanged and are firmer than for some time past. Most mills are asking 1.05c to 1.10c for common iron, although here and there can be found one willing to sell at 1c. Guaranteed iron is quoted at 1.10c to 1.20c.

RAILS AND TRACK SUPPLIES.—Orders are fairly good, both for light and heavy sections. No very large single orders have been placed. Quotations are made: Rails, $19 to $21, according to specifications; steel splice bars, 1.20c to 1.30c; track bolts with square nuts, 1.80c to 1.90c; hexagon nuts, 1.90c to 2c; spikes, 1.55c to 1.60c.

BILLETS AND RODS.—Business has been light, orders for billets in small quantities constituting the bulk of the trading. Prices are unchanged at $15 for billets and $21 for rods.

STRUCTURAL MATERIAL.—There is still a good call for bridge material, and while sales have not been especially large in the last week there is every prospect that a good volume will continue to come in. Two or three building have come up which will require quite large lots of material. The Historical Society building at Madison, taking 1,000 tons, will be let in the next week or ten days. Two office buildings in Chicago, calling for 1,000 tons each, will be let soon. A large building at New York has just been taken by a Chicago contracting firm, and this will require about 1,500 tons of steel, which will probably be placed through the Chicago office of a Pittsburg mill. Aside from these there is only a light demand for building material. The market continues firm. Quotations are as follows: Beams and channels, 1.15c to 1.20c; angles, 1.10c to 1.15c; plates, 1.10c to 1.15c; tees, 1.30c to 1.40c. Small lots from stock are quoted one-quarter to one-half cent higher.

PLATES.—Quite a good business has been done, and the local mills are now assured of work for several weeks to come. The demand keeps up, and further orders are expected to be placed. Quotations are firm and are made as follows: Tank steel, 1.10c to 1.20c; flange steel, 1.30c to 1.35c; fire-box steel, 1.85c to 5c.

SHEETS—The market has been quiet, with little business closed in the past week. Buyers apparently have supplied their wants for some time ahead. Quotations are made at 1.90c to 2c for No. 27 black, and 80 and 5 to 80 and 10 per cent off for galvanized.

MERCHANT STEEL—Several good contracts were taken last week, and the general run of small orders was fair. The demand indicates a continuance of a good business. Quotations are as follows: Open-hearth spring, tire and machinery steel, 1.60c to 1.70c; smooth finished machinery steel, 1.50c to 1.55c; smooth finished tire, 1.35c to 1.40c; tool steel, 5.50c to 7.50c; specials, 11c and upwards.

SCRAP.—Except in wheels, little business is going. Orders aggregating about 3,500 tons of old wheels were taken by one firm, at a price near to $10. Other kinds of scrap are quiet and prices are mostly nominal. Old iron rails are quoted at $11.50 to $12, old steel rails at $7.50 to $8 and old wheels at $10 to $10.50. Miscellaneous scrap is quoted about as follows: Railroad forge, $10.50 to $11; dealer's forge, $9 to $9.50; No. 1 mill, $7.50 to $8; heavy cast, net ton, $7.50 to $7.75; malleable cast, net ton, $8.50; axles, $13.75 to $14.25; cast borings, $2.75; wrought turnings, $4 to $4.50; axle turnings, $5.50 to $6; mixed steel, heavy, $6.25; stove plates, $5.50 to $6; heavy melting steel, $7.50 to $8.

PITTSBURG.

OFFICE OF *The Iron Trade Review*, 807 TRADESMEN'S BUILDING, July 14.

Labor difficulties are beginning to untangle. The Bessemer, open-hearth and blooming departments of the American Iron & Steel Works resumed on Tuesday at practically the company's schedule. The finished scale will doubtless be settled during the week. J. Painter Sons Co. started their plant in part on Tuesday with non-union labor. The volume of business in finished material continues steady and almost every line now feels some betterment. Pig iron is weak and billets show no life whatever. Final negotiations over the Soho furnace have been closed and Laughlin & Co., Ltd., have a two years' lease and will supply the product to their kindred interest, Jones & Laughlins, Ltd.

PIG IRON.—The coal strike has deferred the blowing in of the Raney & Berger Furnace at New Castle by Naylor & Co., and likewise the Soho Furnace, Pittsburg. The former will be operated with by-product coke and the result of the miners' strike will be awaited before blowing in. Bessemer iron is quoted at $9, valley furnace, and $9.30 to $9.50 is asked for Pittsburg iron, but no considerable sales of either are reported. Gray forge is held at $8.35 to $8.50. We quote:

Bessemer at valley furnace	$ 9.00 to $ 9.10
Bessemer delivered Pittsburg District	9.30 to 9.50
No. 1 Foundry	10.25 to 10.50
No. 2 Foundry	9.50 to 9.75
No. 3 Foundry	9.00 to 9.25
Gray Forge	8.40 to 8.50

BILLETS.—The nominal quotation on billets is $14, at maker's mill. Valley and Pittsburg mills are poorly filled with orders.

RAILROAD AND TRACK SUPPLIES.—The working of the Duquesne Steel Works on rails has proved unsatisfactory for various reasons and the mill will return to sheet bars as soon as the heavy rail orders are filled. At present, standard rails are being turned out. Quotations are made on track material as follows: Splice bars, 1.10c to 1.15c; track bolts, iron, 1.65c to 1.70c; steel spikes, 1.45c to 1.55c. Links and pins are quoted at 1.20c to 1.25c.

STRUCTURAL MATERIAL.—For the fifth consecutive week the Homestead Steel Works are running full in every department. The State bridge over the Susquehanna River at Catawissa was awarded the Penn Bridge Co. The plain material has not yet been bought. Twenty-five bids have been submitted for the New Orleans drainage work and the final letting will come after the 14th, the date set for opening of bids. For the time being cutting of prices has ceased. Quotations are no higher but are more closely maintained. Beams and channels of all sizes are held at 1c to 1.05c; universal plates, 1c to 1.05c; tees and zees, 1.15c to 1.25c.

PLATES.—Plates are quoted at 1c to 1.05c for Bessemer tank; 1.05c to 1.10c for open-hearth; 1.20c to 1.25c for shell, and 1.25c to 1.30c for flange. Boiler and fire-box steel of special makes are firmer in price.

BARS.—One of the largest contracts for steel bars placed so far was divided among three Pittsburg mills and a valley mill in the week. The contract covers the season's wants of an agricultural concern in the Central West. Wants of this character are now quite well covered. Steel bars are held at .95c to 1.c; iron at 90c valley and 1c Pittsburg.

MERCHANT STEEL.—Quotations are made as follows: Open-hearth spring, 1.35c to 1.40c; open-hearth machinery, 1.15c to 1.20c; machine straightened tire, 1.25c to 1.30c; soft steel bars, 1.25c; toe calk, 1.35c to 1.40c; sleigh shoe, 1.25c; tool steel, ordinary, 5c to 7c; branded, 10c upwards.

IRON AND STEEL SKELP.—Quotations follow: Grooved steel skelp, 92½c to 95c; sheared steel skelp, 1c to 1.05c; grooved iron skelp, 1c to 1.05c; sheared iron skelp, 1.15c to 1.17½c.

FERRO-MANGANESE.—Domestic, 80 per cent, is quoted at $45 to $45.50.

SHEETS.—Black plates for prompt shipment are strong and deliveries are not easily secured. Plates for tinning are likewise hard to obtain for prompt delivery and are bringing better prices in the East than for some time. For later deliveries lower prices can be had. A number of season contracts for tin plate have been made in the last few days. Galvanized sheets are inactive and are quoted at 80 and 5 per cent off list. No further conference has so far been arranged for on the sheet scale. There are indications that the scale will be signed by certain mills this week. In this case others will probably follow. On black sheets we quote: No. 26, 1.85c to 1.90c; No. 27, 1.90c to 1.95c; No. 28, 1.95c to 2c.

PIPES AND TUBES.—After its customary shut-down the National Tube Works Co. resumed on Monday. The Pennsylvania and American mills are likewise running steadily. Individual companies have been advancing prices for ten days and it is now said that an early agreement will be reached by some of the leading producers to advance and hold prices. On casing and tubing quotations are from 5 to 10 per cent higher and, by the larger interests, are firmly held. Discounts are made as follows: Merchant black, 57 to 67 per cent off; galvanized, 52 to 55 per cent off; six tens for less than carload lots, six tens and 2½ per cent on carload lots. On boiler tubes higher prices are quoted: Two and a quarter inch and smaller, 75 per cent discount; two and a half inches and over, 75 and 10 per cent discount. The following quotations on casing are firmly maintained: Screw and socket joint, 62½ per cent discount; inserted joint, 57½ per cent discount. Certain mills are asking higher prices.

OLD MATERIAL.—Old steel rails and wrought scrap change hands occasionally at widely differing prices. Quotations are entirely nominal and delivery, location and the size of the lot determine the price.

IN OTHER MARKETS.

[SPECIALLY REPORTED FOR THE IRON TRADE REVIEW.]

Cincinnati. Two Covington rolling mills have signed the Amalgamated Association scale, an indication of orders for bars and sheets in this district, that call for early rolling. There is no change in prices of finished material; certainly no greater firmness. In pig iron, a fair number of orders has been booked in the past week, particularly on Southern brands. Consumption continues at a satisfactory rate and prices are very firm. Quotations show average figures, some of the furnaces asking considerable more for grades of which they have short supply. There is little pressure to sell and buyers do not even suggest that prices will go back again. There is no change in Northern irons. It is not expected that there will be any improvement until the labor troubles are settled. We quote: Southern coke, No. 1 foundry, $9.75; No. 2, $9; No. 3, $8.75; gray forge, $8.50; mottled, $8.50; No. 1 soft, $9.50; No. 2, $9; Hanging Rock charcoal, No. 1, $14.50 to $15.50; Tennessee charcoal, No. 1, $12.50 to $13; Jackson County silvery, No. 1, $12.50 to $13; Standard Georgia car wheel, $14.25 to $15; Tennessee car wheel, $13 to $14.

Philadelphia There is no promise in recent business in iron and steel of the better prices which some have inferred were soon to be reached by the iron industry. Buyers have no idea of paying higher prices, and the condition of mill order books and the idle mill capacity are strong support of their position. Business in finished material is quite dull, in spite of the shut-down of Western bar iron and sheet mills. There is a sharp struggle for immediate business and the supply is not as plenty as was looked for. There is general confidence that the fall trade will be good, but a dull summer is expected. In pig iron, while there is no change in quotations, the firmness apparent two and three weeks ago is less talked about. Where it is necessary to realize, quotations are being shaded. This causes some irregularity in prices and we widen somewhat the range ofquotations on standard brands, seaboard delivery: No. 1 X foundry, $11.75 to $12.50; No. 2, $10.50 to $11.25; No. 2 plain, $10.25 to $10.50; standard mill irons, $10.25 to $10.50; ordinary mill irons, $9.75 to $10; basic, $10.50 to $11; low phosphorus, $14.50 to $14.75. Billets are very dull; small lots have sold at $16.25, delivered at tide. On finished material prices are made: Refined bars, 1.10c; special bars, 1.20c to 1.25c; soft steel bars, 1.05c to 1.10c; plates, 1.15c to 1.20c; angles, 1.15c to 1.20c; beams and channels, 1.25c to 1.35c.

Buffalo. The pig iron market for the past week has been less active than either of the last three or four weeks, which, however, is not surprising, as it would be difficult to keep up the recent pace indefinitely. The sales for June in local pig iron offices exceeded all previous records. While the volume of business has been large, the prices were and continue to be, exceedingly low and very unsatisfactory to the manufacturers of pig iron. Nothing but a desire to keep works in operation and hopes for a better future would warrant existing figures. Prices remain unchanged as quoted below: No. 1 foundry, $10.50 to $10.75; No. 2 $10.25 to $10.50; Ohio strong softener No. 1, $10.50 to $10.75; No. 2, $10.25 to $10.50; Jackson County silvery No. 1, $13.50 to $14; Southern soft No. 1, $10.75; No. 2, $10.50.

Autumn Meeting, Iron and Steel Institute.

The autumn meeting of the Iron and Steel Institute will be held at Cardiff on Tuesday, Wednesday, Thursday and Friday, the 3d, 4th, 5th and 6th of August. The following papers have been offered for reading:

"Passive Iron," by J. S. De Benneville, Philadelphia, Pa.; "The Diffusion of Sulphides through Steel," by E. D. Campbell, Ann Arbor, Mich.; "The Manufacture of Tin Plates," by George B. Hammond, Penarth; "A Spectroscopic Analysis of Iron Ores," by Prof. W. N. Hartley, F. R. S., and Hugh Ramage, Royal College of Science, Dublin; "Improvements in Shipping Appliances in the Bristol Channel," by Sir W. T. Lewis; "The Iron Industry of Hungary," by D. A. Louis, London; "A Thermo-Chemical Study of the Refining of Iron," by Prof. Honcré Ponthière, Louvain; "Carbon and Iron," by E. H. Saniter, Wigan; "Some Mechanical Appliances at Penarth Docks," by T. Hurry Riches, Cardiff; "The Application of Traveling Belts to the Shipment of Coal," by Thomas Wrightson, Thornaby-on-Tees.

C. J. Hodge, the iron manufacturer of Houghton, Mich., who has been in Utah for two weeks, operating the North Last Chance mine at Bingham, has returned to the East.

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DEVOTED TO IRON AND STEEL MANUFACTURE, FOUNDRY AND MACHINERY TRADES.

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THE COST OF WORLD-MARKET SUPREMACY.

Mr Swank has a noteworthy article, three pages long, in the last issue of the *Bulletin*, under the title "The British Workingman under Victoria and Her Immediate Predecessors." Starting with a reference to the prosperity which was commented on so generally in Jubilee week as a prominent feature of the 60 years of English history under Victoria, Mr. Swank marshals a formidable array of witnesses as to the character of this prosperity and some of the means used to attain it. Quoting from the article in the July *Forum* the statement by Prof. Davidson that English manufacturers have aimed, by means of the severest competition, even at a loss to themselves for a time, to destroy foreign competitors and gain and keep possession of foreign markets, the *Bulletin* says that the industrial warfare which Great Britain has waged against other nations, at first with the aid of the most stringent protective tariff legislation the world has ever known and afterwards through a free trade policy dating from 1846, has not produced the highest moral, social and intellectual development of which her working people are capable, and adds: "Great Britain has subordinated the best interests of her toiling masses and the highest capabilities of the nation to her unworthy greed of present gain."

Then the witnesses are called, and at length quotations are made from the writings of English statesmen, political economists, manufacturers, and students of social and industrial problems. The deplorable condition of female labor and child labor in mines, in brickyards, in tin plate works, in nail and chain works, at forges and in other employments fit only for men, is described as brought out in official inquiries and in the investigations of competent writers for the press. Much of the misery of these working women and girls and boys has been abated, it is true, though in many cases only recently. Yet the report of Her Majesty's inspector of mines for 1896 shows 5,114 women and girls employed in British coal and other mines. And so recently as 1890, the London *Iron and Steel Trades Journal* said that "the great obstacle to tin plate making on a large scale in the States is the entire absence of cheap female labor so necessary in the industry and so abundant in Wales." And only 20 years ago, Mr. Bleckley, a member of the British Iron Trade Association, said at the meeting in February, 1896, that he considered it a hardship that children of 12 years of age were not allowed to work in the rolling mills.

Some of the quotations made from British authority in the *Bulletin* article throw a startling light on the cost, in human wretchedness and hopelessness, of this remorseless warfare for commercial supremacy. In conclusion this is said:

> That England, Scotland and Wales have made great progress during the Victorian era in all the arts of an exalted civilization, and that their people are now better governed than when that era had its beginning, we are glad to record; but much of this progress has been accomplished despite the opposition of Britain's ruling classes, much of it is the result of the scientific inventions of a wonderfully scientific age, and much of it is traceable to the influence of the freedom-loving spirit of the new era in the world's history which was ushered in by the American Revolution. The fact remains, however, that the condition of the average British workingman—the agricultural laborer, the coal miner, the factory hand, the iron worker, the London dock hand—is still deplorable.

It is to be feared that in the struggle that is ahead, in which the natural and acquired advantages of American producers will make them competitors of British manufacturers as never before, the outlook for British wage-earners is not as bright as could be wished.

FOREIGN STUDY OF AMERICAN METHODS.

The interest of foreign iron and steel manufacturers in the commercial and technical sides of American practice in corresponding lines is increasingly in evidence. The Iron and Steel Institute American tour of 1890, and the British Iron Trade Association's commission of 1895 that visited Belgian and German iron works, may be followed at no distant day by another voyage of discovery, this time to find out how American blast furnaces and steel works have been able to revolutionize costs in less than half a decade. But, meantime, visitors are coming across the water singly and in twos and threes, representing British and Continental works, to learn at first hands the secret of the remarkable tonnage records and of the surprising lessening of costs.

There was not so much curiosity as to practice on this side, so long as it was known in a general way that wages in the United States were high, that fuel methods were wasteful and that an abundant home demand kept the eyes of our manufacturers from wandering to distant fields. But it has not been appreciated abroad that home competition can be as effective a spur to technical progress as the struggle to maintain a position, or to gain a new one, in outside markets. And it has come about that the very protective tariff which our foreign friends have pointed to as the stone wall that would keep our products in, as effectually as it kept some of their wares out, has been a prime developer of our iron and steel industries, and has steadily exerted a pressure toward low costs. Thus while the technical staffs of our steel companies have been

wrestling with ways and means of reducing the unit of cost, to get more of the home business, other influences of a commercial nature have been at work. Among the latter are the development of the Mesabi range, with its unparalleled cheapness of mining; the steady reductions in freights due to the overbuilding of railroads; and, in general, the panic reaction throughout the country from the boom basis of values in the decade preceding 1893.

It may be said that the present combination of low-cost factors will not endure in the United States. We have spoken of this in some detail on other occasions. But apart from other considerations, it is to be borne in mind, in this connection, that the United States has still before it all that can be gained in the fuel field. Germany and Belgium have had the benefit of fuel economies to the fullest extent, while Great Britain, even though it should go into by-product recovery in coke-making, will be continually handicapped by the increasing cost of mining coal.

We repeat, that foreign ironmasters and metallurgists will find more, rather than less, occasion to study American practice in iron and steel, in the decade just ahead.

The New Carnegie Road Nearly Ready.

Such progress has been made on the Pittsburg, Bessemer & Lake Erie Railroad, popularly known as the Carnegie line, that it is now given out that 42 miles of new road, from Butler, Pa., to Bessemer, will be completed by Aug. 20. The contract date is Sept. 1. Work was begun in August of last year and it has been pushed with unusual vigor. The line was built with a view to the quick transit of the heavy material which will constitute nearly all its traffic. The passenger, express and mail business of the original Pittsburg, Shenango & Lake Erie—that part of the line from Conneaut, O., to Butler, Pa.—will still be retained, but on the new 42 miles from Butler to Bessemer there are no stations and no effort will be made to build up passenger business.

The construction is the heaviest ever put on a line of railroad for its entire length. The rails are 100 lbs. to the yard, the locomotives are of the heaviest pattern and the cars are all of steel, with a capacity of 50 tons each. For the bridges 12,000 tons of steel was used and the amount of excavation was 2,500,000 cubic yards. The trestles are from 30 to 135 feet high and their total length is 2¼ miles. The cost of the work has been heavy, because no expense was spared to insure easy grades. There is a 30-foot stretch at one point on the line where no grading was done, but this is all. The average easy railroad grade of 50 to 60 feet per mile has been reduced to a maximum of 31 feet on the southbound trip and to a maximum of 39 feet on the northbound or return trip, on which trains will be lightest.

Ore, coal and coke will be the freight staples of the road and ore will furnish the bulk of it. The estimate of tonnage for the year from June 30, 1897, based on the present traffic of the old line and ore contracts that begin with Sept. 1, 1897, is 2,200,000 tons. It is figured that the total for a year, within 18 months after the opening, will be 4,000,000 tons, with an average haul of 118 miles.

On the southbound trip, there are only five heavy grades and two on the northbound trip. Provision will be made for assisting engines on these grades.

The weight of trains will be the maximum possible on a general grade of 15 feet to the mile. The maximum net weight of trains southbound, which will be the ore trains, will be 1,500 tons. As the character of this freight will admit of the loading of the cars to their full capacity, 50 tons each, and as the lighter freight to be carried north is expected to admit of the loading of trains so as to bring the grand average of weight of all trains in both directions, loaded and light mileage, to not less than 500 tons, it is asserted the Pittsburg, Bessemer & Lake Erie road will show the highest average of any railroad on the continent for any considerable distance of haul.

By-Product Coke Plants Projected.

It is announced that the Semet-Solvay Co., of Pittsburg, which was chartered about a year ago by R. M. Atwater, of Syracuse, N. Y., Michael Trump and others, will build a plant of by-product ovens at Pittsburg. The company is operating under license from the Solvay Process Co., covering Pennsylvania. Sixty ovens will be built, to begin with, at a cost of $200,000 and the number may be increased later. A site has not been selected as yet, but plans for the plant are nearly completed. A project is also on foot for the erection of a block of Semet-Solvay ovens in the Wheeling district, and it is reported that the Riverside Iron Works have the matter under consideration. The pressure upon pig iron prices in the past six months has given a new stimulus to the investigation of fuel economies, and it may be expected that with cheap money and under a gradual improvement in industrial conditions a number of investments of this character will be made.

Obituary.

Col. James Andrews, a structural engineer of note, and well known as the builder of the Eads bridge at St. Louis, died in Pittsburg, last week, aged 73 years. Col. Andrews was a native of Scotland, and came to this country in 1840, as a stone mason. Later he began contracting for larger work in which, in time, he became connected with Capt. Eads. Together they built the jetties at the mouth of the Mississippi, and at the time of Capt. Eads' death were working on a proposed canal across the isthmus of Tehuantepec. Col. Andrews formed the Pittsburg Steel & Iron Mfg. Co. in 1895 and managed the affairs of the company. At the time of his death he was interested in a company that is working on a new method of welding metals.

Personal.

Herman Roechling, son of the principal proprietor of the Roechling iron and steel works, of Voelklingen, Germany, has been in the United States for several weeks, visiting the principal iron and steel centers, the Lake Superior iron mines and other districts. Mr. Roechling's investigations are an illustration of the great interest European iron and steel manufacturers are now taking in American methods in corresponding lines. The Uehling casting apparatus and the Garrett rod mill, in particular, were investigated with a view to their installation in the plants with which Mr. Roechling is connected. Referring to blast furnace practice, he was impressed with the low fuel consumption attained in particular districts in this country; though in this connection it is to be said that the German practice that uses but 2,000 pounds of coke with 33 per cent ores, is worthy of note. It would seem that methods of filling at German furnaces are well advanced, and the devices there employed for the distribution of ores, keeping the coarser ores alongside the furnace walls and throwing the fine ores toward the center, might be worth the study of furnacemen having much to do with Mesabi ores. Wages paid for German furnace labor are nearer to the American standard than might be supposed—95 cents a day for laborers and from $1.15 to $1.25 for bottom fillers.

General Sales Agent George H. Wightman was added to the board of managers of the Carnegie Steel Co., Ltd., last week, to succeed John G. A. Leishman, who sailed on Wednesday of this week for Switzerland.

Chas. H. Hall, of the Lake Superior Iron Co., Ishpeming, Mich., and W. D. Rees, of Cleveland, are named in a Joplin, Mo., dispatch as having purchased for $25,000 a 43-acre tract of lead and zinc lands.

William H. Switzer has been elected president and general manager of the Superior Foundry Co., Little Falls, N. Y.

FINAL negotiations have been closed whereby Laughlin & Co., Ltd., owners of the Eliza Furnaces, secure a two-years' lease of the Soho furnace at Pittsburg. The deal has been in suspense for some time and at one time seemed likely to fall through. The negotiations were conducted by W. P. Snyder and it is rumored that several deals hinge on it. The lease, however, is to Jones & Laughlins' identified furnace interest, Laughlin & Co., Ltd. The furnace was relined last year and is equipped with new engines. It will be blown in soon.

GREAT POWER PLANT IN A UTAH CANYON.

In the canyon of the Ogden River, near the city of Ogden, the latest and most important hydraulic power plant of that State, and one of the largest works of the kind yet undertaken in this country, has been carried out during the past year by the Pioneer Electric Power Co., of Utah. Ogden is situated in the basin of Salt Lake, at an elevation of 4,300 feet above sea level, about 13 miles east of the lake and 35 miles north of Salt Lake City. The city extends eastward to the base of the Wahsatch Mountains, which tower 5,000 feet higher, reaching a total altitude of fully 9,000 feet above sea level. This chain of mountains is intersected by numerous deep valleys or canyons, forming the outlet for drainage areas of considerable extent. The outlet of the canyon of the Ogden River is east of Ogden and distant about two miles from the business center. It is a narrow winding gorge, walled in by high and precipitous mountains, nowhere more than a few hundred feet in width at the bottom, while at some points it is so narrow that the construction of the excellent macadamized road that traverses it involved considerable rock excavation. At a point about six miles above its mouth the narrow gorges through which the river flows widens out into a valley, some

FIG. 1.—EXTERIOR OF POWER HOUSE, SHOWING ONE VENTURI METER AND RECEIVER.

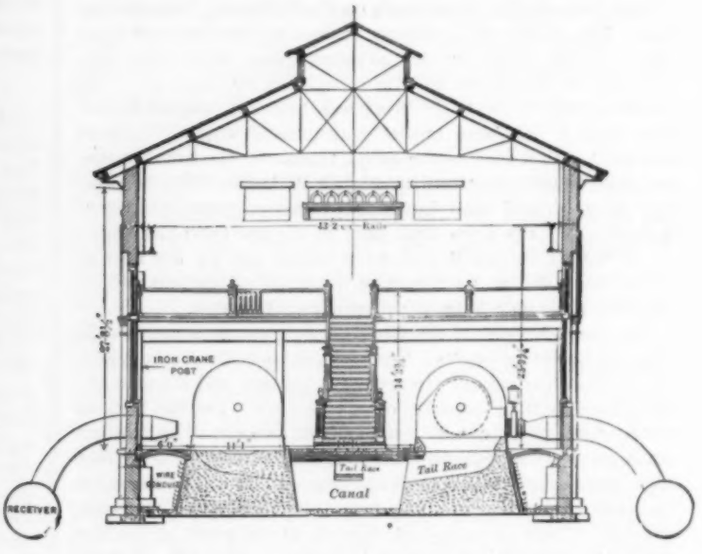


FIG. 2.—SECTION OF POWER HOUSE.

eight miles long and four miles wide, surrounded by an almost continuous mountain chain. This valley is traversed by three streams which unite at the upper end of the canon to form the Ogden River.

The slope of the stream in the upper valley is comparatively gradual, while in the six miles of the canon there is a total fall of nearly 500 feet. This portion of the river has long appeared an attractive field for the development of power, but apart from a small saw-mill near its mouth there have been only abortive attempts made at utilizing the fall of the stream.

The plans of the Pioneer Electric Power Co. contemplate the utilization of the waters of the entire Ogden River watershed above the mouth of the canyon for the development of power, as well as for irrigation. The central features of the plant are: A large storage reservoir and a masonry dam at the upper end of the canyon; a pipe conduit six feet in diameter; a power house with water-wheels and electric generators, electric transmission lines and sub-stations for distributing the power to different points, and an extended system of irrigation canals.

The storage reservoir will cover an area of about 2,000 acres and will have a capacity of nearly 15,000,000,000 gallons. It will be formed by building across the canon, a short distance below its upper end, a dam of concrete masonry built up of isolated piers and arches founded on bed rock. The length of the dam on its crest will be about 400 feet. It will have a total height of 100 feet, 60 feet of which will be above the level of the present river bed. The up-stream face is protected by a steel plate covering to prevent abrasion and percolation.

A nine-foot tunnel excavated through the solid rock around the south abutment of the dam forms the outlet for the water of the reservoir. At its upper end it connects with a masonry inlet tower, which is in turn connected by a riveted steel pipe eight feet six inches in diameter, with the main gate-house 100 feet below the tunnel. This contains two 72-inch valves, one controlling the supply of the main conduit, the other discharging the surplus water.

The main conduit is a pipe line six feet in internal diameter. Its total length is 31,600 feet, of which 27,000 feet is wooden stave pipe and 4,600 feet at the lower end riveted steel pipe. It is laid in a trench 8½ feet wide and covered with earth to a depth of three feet on top. The selection of smooth wooden stave pipe in lieu of steel pipe throughout was made on account of the greater cheapness of the former, as well as its less internal resistance to the flow. The pipe is laid along the side of the canyon. The maximum hydrostatic head in the wooden pipe is 117 feet, giving a pressure of 50 lbs. per square inch. From the end of the wooden pipe the steel conduit runs to the power house. The slope of this is quite steep and the pressure is from 50 to 200 lbs. per square inch. It is 60 feet in diameter until it reaches a point 100 feet from the power house where it divides into two branches, 54 inches in diameter, which lead to two receivers, one on each side of the power house. There are 13 elbows in this pipe and its entire weight is over 2,500,000 lbs. The total efficient head from the flow lines of the reservoir when it is full to the center of the receiver is 446 feet.

All the steel pipe sections were bent and riveted at Ogden, in a shop built and equipped with machinery for that purpose. This was done in order to escape the heavy railroad charges which would have been necessary had the rolled sections been built at the works. The building was equipped with all the machinery necessary for bending, punching, riveting and calking the pipe sections, and an air compressor by which the riveting and calking machines in the trench were driven. After about July 15, 1896, when the first plate was punched, the work was carried on night and day and seven days in the week. The steel pipe, after it had passed the riveting machines, was given a prolonged bath in asphalt.

In the riveting of the pipe in the trench, power riveters were used, operated by compressed air at a pressure of from 50 to 75 lbs., and 500 rivets per day of ten hours were driven by each machine.

Between the inlet tower at the dam and the power house there are five large gate valves, beside the smaller blow-off

and relief valves. Three are six feet in diameter, the other two 42 inches. The first two of the larger ones weigh about 23,000 lbs. each, and are in the gate house, the third is placed near elbow No. 2 of the steel pipe line about 100 feet below its junction with the wooden pipe. Its purpose is to permit the closing of the wooden pipe to keep it full of water even when the steel pipe is empty. The head at this point is about 200 feet. The valve has only a single valve stem and is operated by a hydraulic lift supplied with pressure water from the main pipe above the valve. The total weight of this valve is

FIG. 3.—THE PIPE LINE ALONG THE SIDES OF THE CANYON.

52,000 lbs., the heaviest single piece in it weighing about 20,000 lbs. Besides these large valves there are two smaller, each 24 inches in diameter. These are placed between the lower end of the 6 foot pipe and the power house in the 54-inch branches leading to the receivers. These branches are reduced to 42 inches by the use of Venturi motors, thus permitting the use of the smaller valves, which are operated by hand. The pipe is fully provided with air, mud and relief valves. The connection between the main pipe and the branches is made by a breeches casting secured to the steel pipes by cast steel angle flanges and bolts. To withstand the great longitudinal pressure, a heavy concrete block is built around the casting.

The power house is 135 feet in length by 50 feet in width. The roof trusses are of steel, and are supported on steel posts imbedded in the brick walls. A traveling crane of 15 tons capacity, operated by hand power, traverses the building.

The water is delivered from the pipe conduit into two receivers buried in the ground, one at either side of the power house. They are six feet in diameter, and in their general appearance and the material used closely resemble the regular steel pipe conduit, the thickness of the metal, however, being increased to $\frac{7}{8}$ inch in order to allow for the water-hammer.

The receivers are provided with five safety valves each, which discharge when the pressure exceeds 200 lbs. per square inch, and an outlet gate at the bottom. From each of these receivers five 30-inch and one 10-inch intake pipe extend to the walls of the power house to connect with the water-wheel nozzle pipes. Between these intakes and the nozzle pipes are placed the following valves in the order named: One 18-inch geared gate valve, one 18-inch hydraulic gate valve, and one 18-inch butterfly valve.

The Knight water-wheels are 59 inches in diameter, and have 45 bronze buckets cast in one solid piece; 14 of these, when the nozzle ports are all open, will receive the water at the same instant. The centers of the wheels are made of cast steel, the buckets being pressed on these steel centers and secured with bolts. These wheels are keyed to the generator shaft. Each wheel has a capacity of 1,200 h. p., at 300 revolutions per minute, and each is provided with two fly-wheels about 70 inches in diameter, each weighing about two tons.

The armature, armature shaft, two fly-wheels and one water wheel, which comprise the moving parts, weigh 15 tons. This allows a uniform speed to be maintained notwithstanding changes of head in the main pipe or changes in the generator load. The water-wheel, fly-wheels, nozzle and the two hydraulic cylinders controlling the nozzle ports are encased in a steel housing bolted to the machine bed-frame.

The generators are of the General Electric Co. three-phase type, with 24 poles, and at 300 revolutions per minute have an output of 750 k. w. at 2,300 volts and a frequency of 60 cycles per second. The factory tests show that the variation in volts will be less than five per cent with a constant speed, should the full non-inductive load be thrown off or on.

While the transmission lines are at present capable of delivering 3,000 h. p. at the sub-station, with a 10 per cent energy loss, if it should become necessary, the step-up transformers can deliver more than this by changing three wires on their high pressure side and delivering the current into the transmission lines at 27,000 volts. Thus the line capacity would be more than doubled.

The present installation of the power plant is capable of delivering 3,750 k. w. to its lines, but ample provision has been made to increase this amount to 7,500 k. w. by installing five more 750 k. w. machines, as new industries or manufactures spring up as the result of the advantages offered to them in Ogden and Salt Lake City.

The current will be used to drive factories, running electric railways from Ogden to Salt Lake City, to the lake, to Hot Springs, and to light the towns and cities in the north of the State. The surplus water in the storage reservoir will be used to irrigate large tracts of land in the vicinity. The Pioneer Electric Co. has for its president and treasurer Hon. Geo. Q. Cannon, the head of the Mormon Church. The general manager is Frank J. Cannon, son of the president, and United States Senator from the State of Utah. The directorate consists of Wilford Woodruff, president of the Mormon Church, and others, all but two being members of the Mormon Church.

THE FRICK COKE CO'S NEW PRESIDENT.

Thomas Lynch, the new president of the H. C. Frick Coke Co., is 43 years of age and has spent his lifetime in Pennsylvaia. As a store clerk in Uniontown, Pa., he secured his early business training. When Mr. Frick began his career as a coke operator he took Mr. Lynch with him as manager of operations in the field and general details of the business. In the manufacture of coke Mr. Lynch is an expert, both in the

method of its burning and in judgment of its quality afterwards. He has a wonderful capacity for detail, as evidenced by successful management of 13,000 coke ovens and as many men for the past 10 years. Notwithstanding the many labor troubles that have occurred in the Connellsville region, in all of which Mr. Lynch was directly concerned, there will be general regret at his departure from the field of operations, to take up the duties devolving on him at Pittsburg.

LAKE SUPERIOR MEETING, A. I. M. E.

The excursion portion of the Lake Superior meeting of the American Institute of Mining Engineers opened Friday evening, July 9 at Buffalo, when the Eastern delegation took the steamer Northwest at Buffalo. It was expected originally that 150 persons would make the trip, but the number of those prevented from going, by hot weather or by business impediments, grew rapidly at the last and the Buffalo party, augmented at Cleveland and Detroit on Saturday, finally footed up between 75 and 100. Dr. David T. Day, who has very successfuly piloted the Institute on other like trips, was in charge and the members found an admirable arrangement of details for a comfortable and profitable trip. On the way up the Lakes sessions were held for the discussion of papers, those distributed on the boat including the following: "Methods of Iron Mining in Northern Minnesota," by Prof. F. W. Denton, of Minneapolis; "The Cyanide Process"—communications to the secretary, on the papers at the Chicago meeting; "Microstructure of Steel and the Current Theories of Hardening"—continuation of the discussion of Mr. A. Sauveur's paper presented at the Colorado meeting last September; "The Potsdam Gold Ores of the Black Hills of South Dakota," by Frank Clemes Smith, Rapid City, S. D. The paper of Prof. Denton, which had been prepared for the Chicago meeting, is an able and comprehensive discussion of iron mining methods on the Vermilion and Mesabi ranges, plentifully illustrated with half-tone cuts and plan drawings, together with a map of the Northern Minnesota mining region. We quote merely the concluding paragraphs of Prof. Denton's excellent monograph:

"Mining on the Vermilion range has reached a settled, fixed system, and ranks with the best practice on Lake Superior. It is not probable that any radical change will be made in the future, as the present methods are the results of considerable experience and the conditions arbitrarily limit the methods of mining.

"On the Mesabi range, however, one is forced to the conclusion that no company is yet satisfied with its method of underground mining. Experiments are being tried constantly; schemes are talked of continually; and, with the best talent on Lake Superior at work on the problem, it is possible that in the near future some new system will be developed which will be considered the best. Thus far the practice has been to apply to the new conditions the well known systems of the older ranges, from which those directing the work came. It is difficult, however, to see whence any radical change of present methods can come, except in the development of open-pit mining.

"In a previous paper the writer attempted to determine the difference in the cost of mining ore underground and in open-pit, exclusive of stripping-cost, and placed it at 21.5 cents per ton. Although the data from which this difference was computed were not as extensive as one would wish, it is still believed to be a conservative estimate, and one may reasonably expect open-pit work to become much more highly developed in the future than it is at present. The cost of opening and certain risks would be increased, perhaps, by open-pit mining; but the advantages obtained would seem to justify such additional expense and risk. Thorough and accurate preliminary exploration, the importance of which is becoming more and more recognized, would remove all risks."

Arriving at Houghton, Mich., Monday, July 12, the party left the Northwest to give a day to the inspection of the famous mines of the copper country. The programme from Houghton on included a night trip by rail to Duluth, arriving there Wednesday morning, July 14. A Duluth & Iron Range special train took the party to Two Harbors for an inspection of docks and shops of the Duluth & Iron Range Road and thence to Soudan. In charge of President D. H. Bacon, of the Minnesota Iron Co., the hard ore mines were visited, many of the party going underground to study the system of filling which has been followed with such excellent results in the mining of these ores.

It was expected that the latter part of Wednesday afternoon would be spent at the Chandler, Pioneer and Zenith mines at Ely. On Thursday, in charge of W. J. Olcott, the members were to be taken to the Biwabik, Canton, Duluth and Cincinnati mines, then to the Fayal, Adams and Cloquet at Eveleth; later to the Virginia group—the Franklin, Norman, Commodore, Ohio, Lone Jack and Oliver—and late in the afternoon to the Mountain Iron, Rathbun and Aetna mines at Mountain Iron. A session of the Institute is planned for Thursday evening, in the opera house at Virginia. Friday is to be devoted to the Hibbing group and Saturday to Duluth, the North Land leaving on the return trip Saturday at 1:45 P. M. The Black Hills excursion leaves Duluth at 1:10 P. M. Saturday.

A pamphlet for the trip over the Minnesota ranges was prepared for the Institute by Mr. Geo. D. Swift, of the Lake Superior Consolidated Iron Mines, Duluth, and Prof. F. W. Denton. It contains an excellent map of the Mesabi and Vermilion ranges, brief notes on the ores of the two ranges, transportation and dock facilities, with analyses of ores, and table of distances.

WAGE QUESTIONS.

The following is the new scale for tin plate mills, as agreed upon at the conference of July 3 between the Amalgamated Association committee and the committee of manufacturers:

"When 100 pounds IC tin plate is selling at a ratio of one-fifth the price per ton of 2,240 pounds of 4 x 4 steel billets, the wage list as given below shall be paid, but in case of a departure in either the selling price of steel billets per ton or 20 boxes of 100 pounds IC tin plate, that will change the above ratio $2 per ton or more, then the wage list shall advance two per cent for each $2 from said ratio, and decline two per cent for each $2 decline to said ratio. It is understood that the list of wages given below is the minimum for the year beginning July 1, 1897, and ending June 30, 1898."

Gauges.	Rolling steel 2240 lb.	Doubling.	Heating.	Shearing on jaw or crocodile shears and sheet work on squaring shears.	Shearing tin plate on squaring shears
				Per ton.	Per ton.
Nos. 8 to 11	$2.04	$0.93	$0.85	$1 10	$ .36
" 12 and 13	2.13	0.96	0.90		
" 14 and 15	2.45	1.10	.07		
" 16 and 17	3.24	1.46	1.32	1.25	
" 18 to 20	3.62	1.63	1.48		
" 21 to 24	4.02	1.86	1.63	1.05	.40
" 25 and 26	4.28	1.97	1.79		.41
" 27 and 28	4.32	2.08	1.93	.98	.43
" 29 and 30	4.90	2.53	2.33	.88	.45
No. 31	5.00	2.66	2.49	.84	.46
" 32	5.22	2.79	2.57	.87	.48
" 33	5.54	2.93	2.70	.90	.51
" 34	6.14	3.12	2.95	1.04	.53
" 35	6.50	3.30	3.13	1.04	.55
" 36	6.87	3.38	3.25	1.09	.57
" 37	6.96	3.42	3.30	1.05	.59
" 38	7.03	3.49	3.35	1.02	.61
" 39	8.00	4.07	3.80	1.12	.63
" 40	8.40	4.22	4.00	1.16	.65
" 41	8.69	4.36	4.14	1.22	.66
" 42	8.80	4.50	4.30	1.26	.67
" 43	9.00	4.65	4.43	1.30	.68
" 44	9.20	4.80	4.57	1.35	.69

The second conference of the sheet manufacturers and the Amalgamated Association committee began at Pittsburg July 8 and continued through July 9, without agreement. Minor points are practically adjusted but there is a strong contention over the manufacturers' protest against 10 per cent increase over iron for rolling steel sheets, gauges Nos. 22 to 32.

The steel scale, or that covering wages paid in the Bessemer, open-hearth and blooming departments of the American Iron & Steel Works of Jones & Laughlins, Ltd., was signed on Monday and these departments resumed work. The scale signed was substantially that asked by the firm and was agreed to by the wage committee of the Amalgamated Association. Conferences on the finished scale have been held and the company's propositions on this scale will probably be accepted during the present week.

J. Painter & Sons Co., of Pittsburg, which on July 1 refused to accept the Amalgamated Association scale, started up a part of its plant on Tuesday with non-union labor. No trouble was encountered and the entire plant will be put to work this week.

The Crescent Steel & Tin Plate Co., of Cleveland, is operating its plant in part, with non-union men. The Amalgamated Association workers insist on a scale signature, but the company will only agree to pay going wages, reserving the right to regulate the mill according to its own rules.

The Works of the Illinois Steel Co.

Among the astonishing developments of this revolutionary period in the American iron trade is the appearance of the steel mills of this country as serious competitors for business in the world's markets. In the case of the Illinois Steel Co., though its works are nearly 1,000 miles from the Atlantic seaboard, being located on the shores of Lake Michigan, while the raw materials are assembled from distances of 300 to 700 miles, the company has overcome such apparent disadvantages and is making its influence felt beyond the seas. In the remarkable reductions in the cost of producing iron and steel in this country, the Illinois Steel Co. has taken a prominent part, its able technical staff having steadily made improvements in plants and methods. In the belief that the iron trade of the world will be interested in a description of the works of this company, the leading facts have been collated and are herewith presented. As a pertinent preliminary, a brief historical statement is given.

The corporation known as the Illinois Steel Co. was formed May 1, 1889, by the consolidation of the North Chicago Rolling Mill Co., the Joliet Steel Co., and the Union Steel Co. This brought under one control five plants, as follows: North Chicago works, established in 1857; South Chicago works, established in 1880; Milwaukee works, established in 1868; Joliet works, established in 1870; Union works, Chicago, established in 1863. The main plant is the South Chicago works. The Joliet works are at Joliet, Ill., and the Milwaukee works are at Milwaukee, Wis. These five plants occupy over 700 acres of ground, and the company also owns coal lands and coke ovens in Western Pennsylvania and West Virginia, iron ore properties in Michigan and Wisconsin, and limestone quarries in Indiana, adding considerably to the acreage above stated.

The company also owns the controlling interest in the Chicago, Lake Shore & Eastern Railway Co., which operates the internal transportation at the different plants, and connects directly, by means of its own tracks and leased trackage, the South Chicago works and the Joliet works with the coal supply in Indiana and Illinois. This railway also connects, by means of its own and belt lines, with all of the railroads terminating in Chicago, and with the extensive docks in the Calumet region. It has 124 miles of track in the various yards, and operates altogether 369 miles. Its equipment consists of 57 locomotives and 3,127 cars. A large number of the latter are actively engaged in the coke traffic from Pennsylvania and West Virginia. In addition to this, the Illinois Steel Co. has 17 miles of narrow gauge track and 32 locomotives operating thereon at various points.

The authorized capital stock of the Illinois Steel Co. is $50,000,000, of whch $18,650,635 has been issued. The works comprise, in all, 17 blast furnaces, four Bessemer steel plants, a very large open hearth steel plant, two modern rail mills, billet mills, twin rod mill, plate mill and merchant mills.

The officers of the company are as follows: John W. Gates, president; Charles H. Foote, first vice-president; William P. Palmer, second vice president; William A. Green, secretary; William H. Thompson, treasurer, and A. M. Crane, general sales agent. The directors of the company are: Nathaniel Thayer, Francis Bartlett, Francis L. Higginson, of Boston; Morgan Rotch, of New Bedford; A. J. Forbes Leith, of London, Eng.; Cornelius C. Cuyler, of New York; Isaac L. Ellwood, of DeKalb, Ill., and Marshall Field, Norman Williams, William L. Brown and John W. Gates, of Chicago. W. R. Walker is general manager; L. D. Doty, purchasing agent; E. A. S. Clarke, general superintendent, South works; C. L. Miller, general superintendent, Union works; W. C. Catlin, general superintendent, Joliet works, and George L. Reis, general superintendent, Milwaukee works.

The finishing department fitting shops at the North works are operated by the Universal Construction Co., of which Edward Haupt is president.

THE SOUTH WORKS.

The South works are located on the shore of Lake Michigan, 12 miles from the center of Chicago, at the mouth of the Calumet River. When the erection of the works was undertaken, in 1880, the property consisted of sand beach about two feet above the surface of the lake. The area increased, mainly by large purchases in 1889, so that in 1887 it comprises 258 acres. The present elevation of the yard, from 6¼ to 16 feet, gives proper drainage for fly-wheel pits, gas flues and regenerator chambers.

The shipping facilities call for special mention. The works are in direct connection with six railroads. In the enclosure are 36 miles of standard gauge and 6½ miles of three-foot gauge track. Water shipments are made from two slips. The South slip, entered from the lake by the Calumet River, is 1,000 feet long and 96 feet wide. A depth of water is maintained sufficient for vessels loading to 18 feet. The ore yards reached by this dock will hold 300,000 tons of ore and when extended, as will be done shortly, will hold 100,000 tons more. Three vessels can unload to the ore yards, one can unload into cars, a fifth can coal up for a voyage, and a sixth can unload lumber, all at the same time. The river frontage of the company is 2,500 feet. Along Lake Michigan the property extends for 5,200 feet. Three thousand two hundred feet north of the river mouth is the North slip, opening with a protected mouth into Lake Michigan. This slip is 200 feet wide and 2,200 feet long. Thus sufficient room is provided to permit of making all shipments of ore required in the season of navigation. Shipments are also made here of all the company's products destined for points reached by vessels either in this country or in foreign ports. Vessels loading here proceed direct to the seaboard via the Great Lakes and the St. Lawrence River, or Erie Canal and Hudson River. In this way steel rails, billets, wire rods, cotton ties, tin plate bar, pig iron, spikes, angle bars, bolts, nuts, etc., are insured quick handling for export. With the present equipment eight boats can discharge and receive cargoes simultaneously, direct to the yards or to cars placed on the dock alongside the vessels, either by machinery or by hand loading.

A total of 1,600,000 tons of ore has been received in seven months at these slips. While the average cargo of ore is a little short of 3,000 tons, the larger vessels of recent build often run over 4,000 tons, such as the cargo of the barge Carrington received on May 5, 1897, of 4,968 tons. When St. Mary's River and the harbors of the ore shipping ports are deepened the cargoes will run up to 6,000 tons.

The ore is handled at the South slip by a series of swinging booms, lifting the ore buckets from the hold of a vessel and dumping into push cars running on trestles over the ore yards; there being 53 of these hoists. At the North slip are 16 cantilever hoists and conveyors of the Brown Hoisting & Conveying Machine Co. An abstract of the record is given showing the best time of unloading vessels:

Season	1895	1896	1895	1897
Boat	Manhattan	G. N. Orr	Manchester	"137"
Cargo (tons)	2,008	2,639	2,750	4,000
Men (including signal boys)	44	81	95	158
Hoists	4	9	7	12
Time (hours)	10	6¼	6½	8½
Tons per hour	201	422	425	471
Tons per man per hour	4.6	5.2	4.6	3.0
Slip	North	North	South	South

At another time a gang of 42 men unloaded a boat of 1,600 tons in the morning, and in the afternoon another of 1,750 tons, or 3,350 tons in all, in 12 hours. This is equal to 80 tons

per man, or 6⅗ tons per man per hour, and was done at the South slip.

Blast Furnaces.

The South works have two separate blast furnace plants of four stacks each. Blast furnaces Nos. 1, 2, 3 and 4, lying along the Calumet River, have bosh diameters of 17 feet 6 inches to 19 feet 6 inches and a uniform height of 75 feet. These furnaces were built in 1880 and 1881. Each furnace has four Whitwell-Foote hot blast stoves 21 feet diameter and 67 feet high. Steam is furnished by 40 horizontal tubular boilers heated by the combustion of the waste blast-furnace gas which is not used in the stoves. A considerable part of the steam raised in these boilers is sent to the Bessemer converting department and used in the blowing engines. Air is blown into the furnaces by ten vertical blowing engines built by the Cuyahoga Engine Co., of Cleveland. These engines have 36-inch steam and 84-inch air cylinder and 54-inch stroke. Two engines are used for each furnace, and two held in reserve for the four furnaces. A stock house, 368 feet by 100 feet, shelters the daily supply of coke. Two brick hoist towers, 100 feet high, raise the stock to the top of the furnaces. The cast houses are built of brick, each furnace having a casting area of 62 feet by 150 feet.

Lying south of the North slip is the plant of blast furnaces Nos. 5, 6, 7 and 8, which were built in 1890. The bosh diameters are 19 feet 6 inches to 20 feet 9 inches, and the height of each furnace is 85 feet. Each furnace has four Massick & Crookes hot blast stoves 22 feet diameter and 74 feet high. Forty-eight horizontal tubular boilers generate steam as at furnaces 1 to 4, and drive 10 Southwark Foundry & Machine Co.'s Porter-Allen vertical engines, arranged as are the Cuyahoga engines. These engines have 40-inch steam and 84-inch air cylinders and 60-inch stroke. There are about 6,500 feet of standard gauge elevated tracks reached by an incline. Below the trestles are storage space and hoppers holding coke, limestone and such ores as are received by rail. Each furnace is served by a double platform vertical skeleton steel hoist tower, operated by a 12 x 12-inch cylinder Crane hoist engine. Each furnace has a brick cast house, 63 x 164 feet, furnished with sand beds and sand runners for taking care of the iron in ladles or beds.

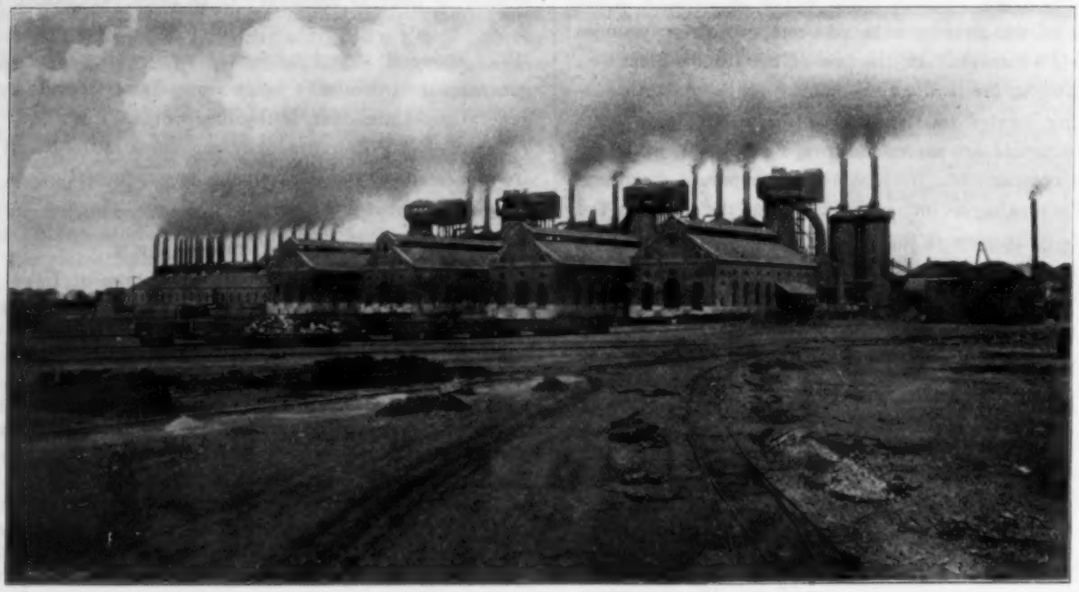


FIG. 1.—SOUTH WORKS. NEW BLAST FURNACES.

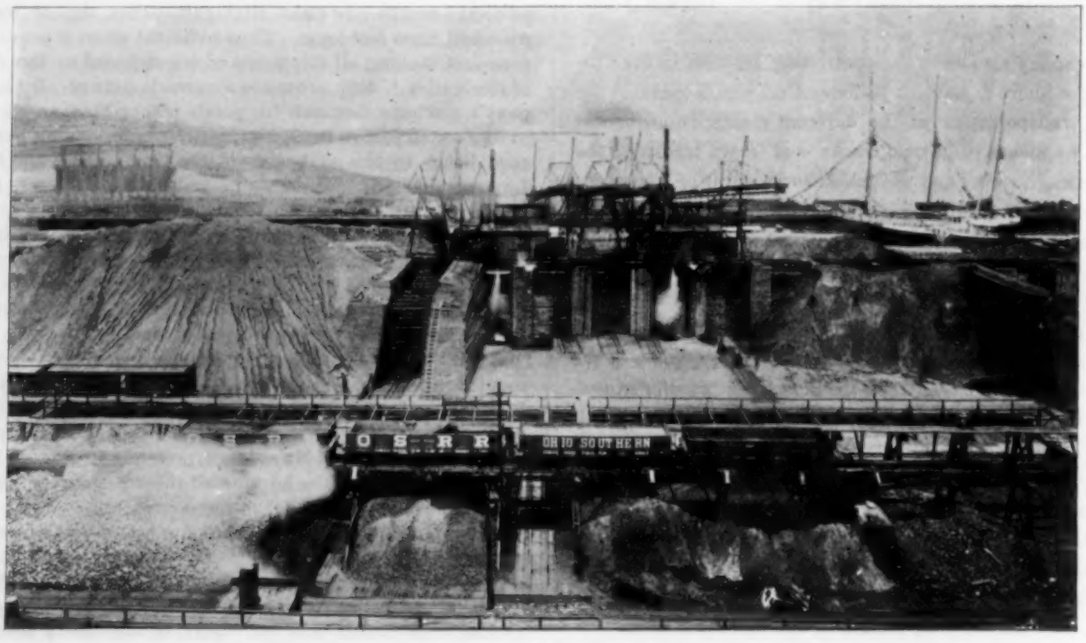


FIG. 2.—SOUTH WORKS. ORE PILES AT NEW BLAST FURNACES.

Adjoining the plant of furnaces 5 to 8 is an establishment in which are made bricks of flue dust, compressed and hardened, so that what otherwise would be a waste is charged back in the furnaces as ore. An excellent quality of building brick of great strength, hardness and cheapness is made from the furnace slag. Another building nearby is used in making mineral or slag wool, extensively used in filling floors,

wall spaces, and for non-conducting covering of steam pipes, etc. The balance of the slag not thus used is broken, making an excellent stone for concrete, street macadamizing or railway ballasting.

No. 1 blast furnace usually makes spiegeleisen and then its product is 7,000 tons per month. With all eight furnaces making Bessemer iron the total output is 80,000 tons per month, or 960,000 tons per year, with a minimum fuel consumption of 1,500 lbs. of coke per ton of iron and the furnace yield of ores from 55 to 62 per cent.

FIG. 3.—SOUTH WORKS. ORE YARD AT OLD BLAST FURNACES.

Bessemer Steel Plant.

Ground was broken for the Bessemer converting works in 1881. Operations began in 1882. Iron is run from the blast furnaces directly into ladles holding 12 tons each on a four-wheel truck for a standard gauge track. When brought to the converting works the iron is poured into the "mixers." These are two vessels, which with attendant machinery were built in 1892. They are revolved by hydraulic power. The capacity of each mixer is 150 tons. By mixing the iron from different casts of the various furnaces an iron of great uniformity of chemical composition and temperature is obtained for the converters.

In addition to the large chemical laboratory in its own building, a complete laboratory is maintained at the converting works from which the steel blower receives analyses, as well as the metallurgist.

Adjoining the mixer building are three iron cupolas in which, when desired, pig iron is melted and delivered to the mixers. These cupolas are of 5,500 tons capacity per week. Two cupolas are 10 feet diameter and one is 11 feet in diameter.

The converters or vessels are three in number, of 12 tons capacity. They are made with removable shells after Holley's plan. Strong hydraulic lifts under the vessels render the handling of shells and bottoms rapid. Of late in changing bottoms a special form of car is used, resulting in increased speed of work. The general arrangement of vessels, cranes, casting pit and hot metal delivery track is of the Forsyth design. In 1893 an intermediate receiving ladle of large capacity was installed. By the double pouring thus

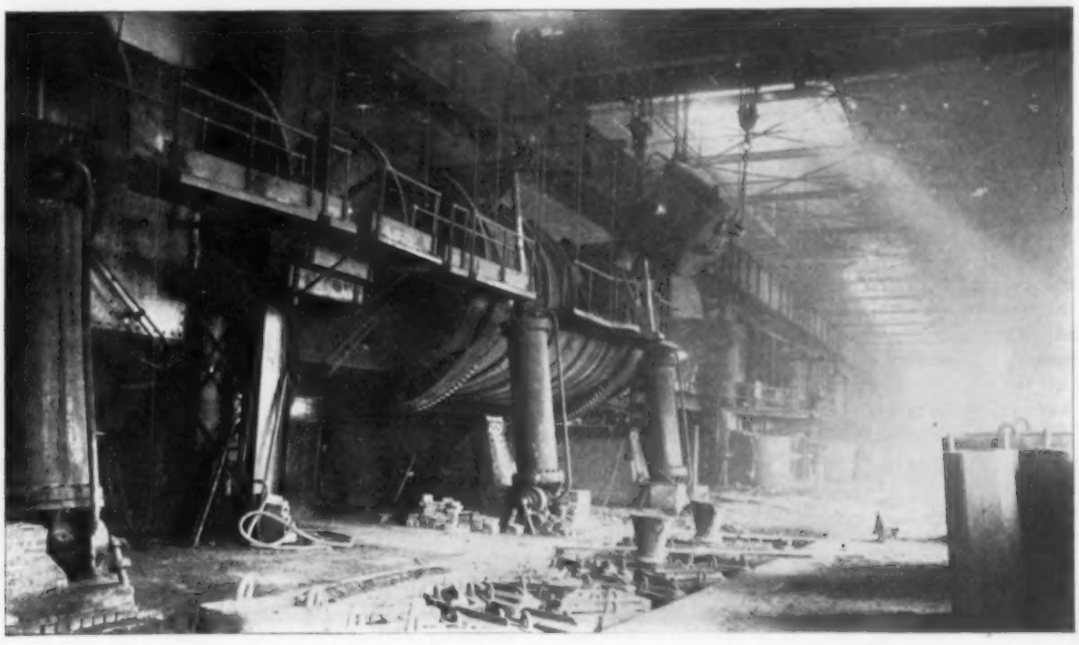


FIG. 4.—SOUTH WORKS. OPEN-HEARTH STEEL MILL.

introduced a perfect dissemination of the recarburizer is secured, so that a very homogeneous steel is made.

The ingots are 16 inches square and weigh from 4,500 to 5,000 pounds. They are poured in open molds standing on cast iron stools. The arrangement of the ingot cranes and pit with reference to the vessels gives over to the ingot molds 250 degrees of the circumference. The pit can hold three heats or 21 ingots, which is ample in capacity. Ingots and molds are handled by three Wellman jib cranes. To these have been added ingenious double tongs, whereby two molds or ingots can be transferred at each lift to or from pit and cars.

Another casting pit back of the repair shop is used in casting ingots of soft Bessemer steel. Spiegeleisen is furnished either by four cupolas or taken direct from the blast furnace, and held in a mixer to be served out in quantities as required. Should the metal in the mixers cool from long delay, it is heated up by oil burners which spray a flame over the iron.

The present capacity of the converting department is over 600,000 tons of steel ingots per year.

The molds are stripped in the casting pit from the ingots as soon as enough of the steel has solidified to permit handling, and the ingots are taken in cast iron cars while still at a white heat to the rail mill.

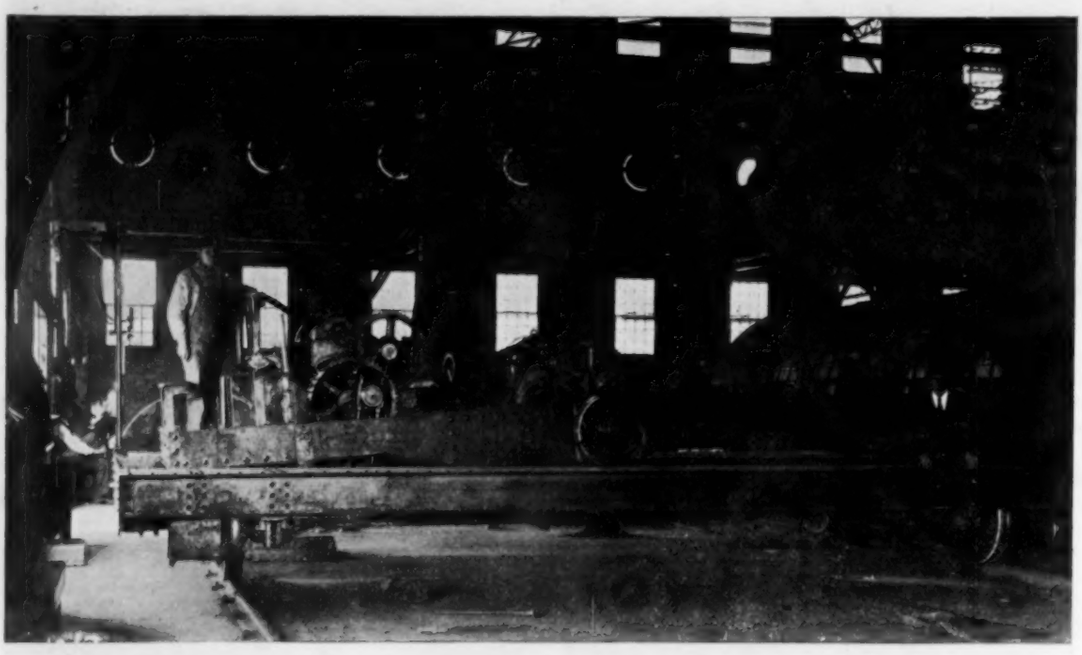


FIG. 5—SOUTH WORKS. WELLMAN CHARGING MACHINE, OPEN-HEARTH STEEL MILL.

Rail Mill.

On arriving at the rail mill, the ingots are picked up by cranes which place them in soaking pits. They stay here to solidify throughout and attain a uniform high heat, and then are rolled into rails. Thus the first time the metal from the blast furnace is allowed to become cold is when lying on the rail mill hot beds in the shape of a rolled steel rail. The soaking pits have 12 holes, rectangular in shape, and hold 10 to 12 ingots. They are fired with oil gas, the air entering through regenerators which have been heated by the waste heat leaving the pits.

The ingots are lifted out of the pits and placed in a tilting cable car by electric traveling girder cranes of 78 feet span, moving horizontally at 300 feet per minute and with 100 feet per minute lift. The ingot is delivered to the table of the blooming mill by the car and passes between the rolls of a three-high 40-inch blooming mill. It is reduced to a bloom eight inches square and about 24 feet long. Before passing to the first roughing rolls the bloom is cut into smaller ones, each of which makes three 30-foot rails. The blooming rolls are driven by a Porter-Allen 44 x 66-inch engine of 1,600 h. p., with a 25-foot fly-wheel weighing 55 tons.

The first roughing rolls and the finishing rolls are driven by a 54 x 66-inch Porter-Allen engine of 2,800 h. p. From the first roughing the bar passes to the second roughing and dummy rolls, driven by a 44 x 66-inch Porter-Allen engine of over 1,700 h. p. These engines have fly-wheels similar in size and weight to the blooming engine wheel, and run at 80 to 90 revolutions per minute. Owing to the shape of the building, which was built in 1882 for a 26-inch two-high mill, the present 27-inch mill designed by R. Forsyth is in two parts, and with blooming mill placed tandem. The ingot is reduced to a bloom in nine passes, after which there are five in the first roughing, four in the second and dummy and four in the finishing, making 13 passes from the bloom to the rail, or 22 in all. After being sawed hot to length of 30 feet by saws running at 1,500 revolutions per minute, the rails are cooled on large beds, loaded from thence mechanically on a transfer car, and similarly unloaded on the beds of the finishing building. This building is 150 x 360 feet and is well provided with straightening presses and drills. After straightening and drilling and passing a severe double inspection by employes of the company and inspectors acting for purchasers, the rails are loaded, weighed and shipped inside of three hours and a half from the time the metal ran out of the blast furnaces. All rails of night manufacture are inspected in the daylight.

The capacity of the mill for a full year is over 450,000 tons of finished rails. On heavy rails, 72 lbs. per yard, the make of June 11, 1896, was 18.2 miles of track in 12 hours or a mile and a half an hour.

A very interesting feature of the rail mill is the exceptionally good facilities for rolling billets of various sizes. Extra passes for billets are turned in every set of first and second roughing rolls, and movable tumblers are provided, whereby a bloom can be worked either in the rail passes or in the billet passes. Extending from the second roughing rolls is the runway, which carries the bar to a duplex hydraulic shear, on which the billets are cut to the specified weights, and they are carried thence by a grade conveyor outside of the rail mill building to the north. From this they drop on a cross conveyor which elevates them to the upper conveyor upon which they run out on the billet dock and drop off on the proper piles.

By the above arrangement any proportion of the product may be made in the shape of billets, as there is no roll changing necessary, and simply giving a signal to the man operating the levers at the roughing rolls will put the bloom into either billets or rails. The rolling and shearing facilities for billets are excellent, as high as 900 tons of 3⅞-inch square billets having been made in 12 hours. It is not an unusual sight to see one bloom rolled into a 3⅞-inch square billet and the following bloom rolled into a rail; the rail being sawed and on the hot bed before the 3⅞-inch square bar has been entirely cut into billets.

There is no other works in the country which has this ar-

rangement for making billets, and it will readily be seen that it is a great advantage to the South works, since it enables the mill to fill orders for billets of any carbon and in any quantity without interfering with the production by loss of time in changing rolls. The weight of rails which have been rolled is from 30 lbs per yard up to 100 lbs., and the length has ranged from 30 to 60 feet. Rails of heavier weights and greater lengths can be rolled as desired.

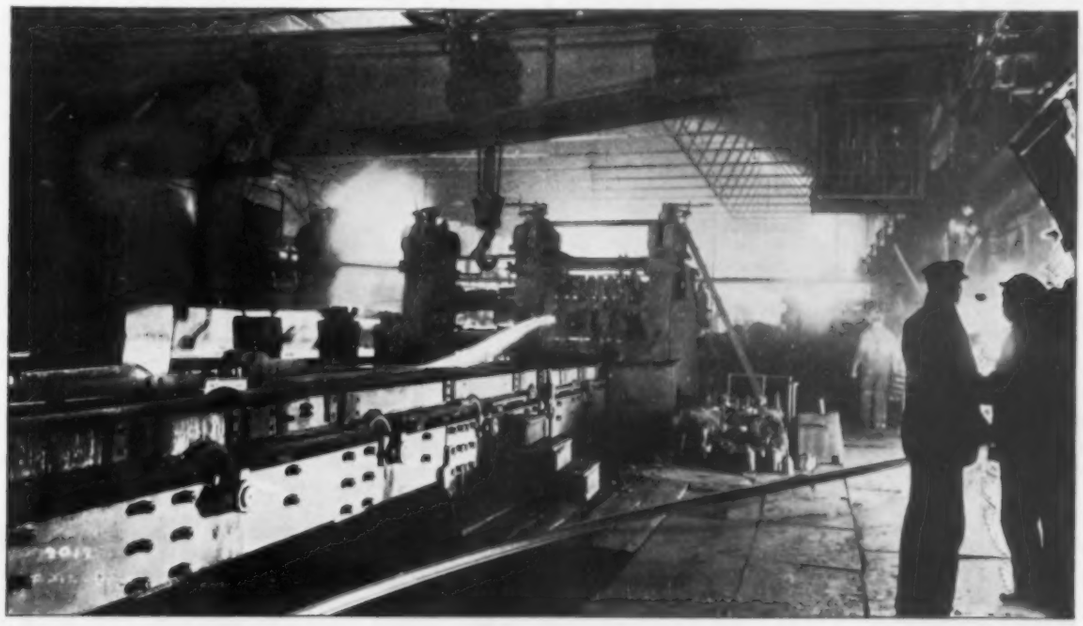


FIG. 6.—SOUTH WORKS. RAIL MILL.

The Open-Hearth Department.

The open-hearth steel department was put in operation in February, 1895. The building containing the furnaces and casting pits is of brick and steel construction, 100 feet wide and 651 feet long.

The furnaces, 10 in number, are placed along the length of the building giving half of the building width for casting and for handling ingots, molds and slag. Back of the furnaces is a charging floor 12 feet above the yard level. The charging floor and furnaces are spanned by a 20-ton electric traveling crane. Over the front of the furnaces and the rest of the building running parallel to its length are one 40-ton, two 30-ton and two 75-ton electric traveling cranes. There are four open-hearth steel furnaces of 25 to 28 tons capacity per heat of the Wellman stationary style of the Siemens regenerative furnace, and two 25-ton and four 60-ton furnaces of the Wellman rolling type. The annual capacity of these 10 furnaces is 175,000 tons of ingots and castings.

Stock for charging the furnaces is loaded at the mills of stock piles in boxes on cars, which are carried on an inclined track to the charging floor and placed directly in front of the furnace doors. The boxes are picked up, pushed into the furnace, emptied and replaced on the car by Wellman electric charging machines, of which there are three. All doors and valves of the furnaces and regenerators are operated by pneumatic cylinders, the cocks of which are worked by a boy on the charging floor. The melted steel is tapped into ladles of 30 to 60 tons capacity, which being suspended from a traveling crane during casting are at once taken to a pit full of empty molds. A steel-lined casting pit 30 feet deep permits the casting of ingots of great size and weight up to 150 tons each. The making of small and intricate castings is quite as carefully attended to as of those of greater size.

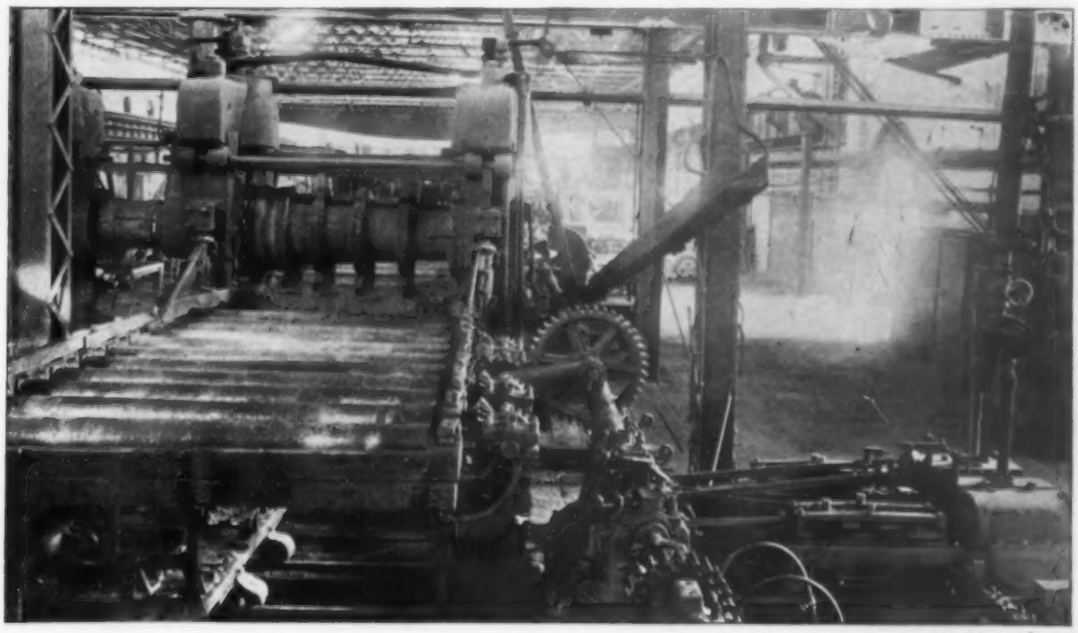


FIG. 7.—SOUTH WORKS. RAIL MILL BLOOMING MILL.

The Plate Mill.

The plate mill was built simultaneously with the open-hearth building. There are five large reheating furnaces

served by two Wellman electric charging cars. Two plate trains, one 90-inch and one 132-inch in length of rolls are driven by a 54 x 66-inch Porter-Allen engine of 3,000 h. p. They are three-high, having the middle roll operated vertically by hydraulic pressure. Finished plates are made from $\frac{1}{16}$ ins. to 1½ ins. thick and up to 126 inches wide and 60 feet long. The capacity of the mill is 84,000 tons of finished plates a year. Much of the machinery in these two departments is

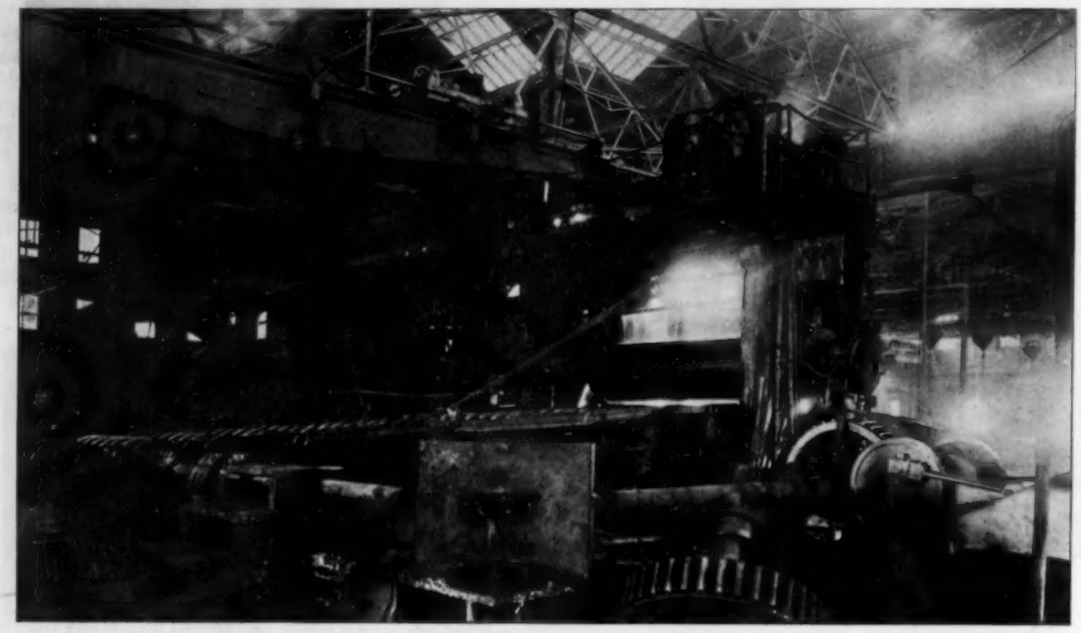


FIG. 8.—SOUTH WORKS PLATE MILL. 90-INCH AND 132-INCH PLATE TRAIN.

electrically driven. A high speed of movement and ease of handling plates of any size rolled are obtained by the use of strong electric magnets, suspended from traveling cranes, which will pick up, transport and lay down plates simply by turning a switch.

Shears of great strength cut plates to any size or shape ordered. One of these shears cuts circular plates with great accuracy. The largest shearing machine has blades 11 feet long, capable of cutting a plate of that width and two inches thick.

The Mechanical Department.

The South works is a self-contained plant. By means of a machine shop 300 feet long and 150 feet wide, an iron foundry, a steel foundry, blacksmith, carpenter and pattern shops of sufficient size, all repairs to machinery are made without delay, new machinery is built, and new construction or extension of the plant undertaken. All of the ingot molds used are made in the iron foundry, which has been successful in securing long service for its molds.

Steam is generated in over 190 boilers. These boilers are mainly 6 feet in diameter, 20 feet long, with 50 4½-inch tubes, and set horizontally in pairs, each pair having a large iron stack. The power obtained by the expansion of the steam used in engines and pumps is over 25,000 h. p., using over 350 steam cylinders.

Blast furnaces 1 to 4, the Bessemer converting works and rail mill have supply water pipes leading from the South slip to their respective pumping plants. At the west end of the North slip is a pumping station comprising four 6 x 20-inch boilers in the boiler house delivering steam to the engine house, in which are three engines. These are compound condensing high-speed Porter-Allen engines, coupled directly each to a Southwark Foundry & Machine Co.'s centrifugal pump. Water is lifted 10 feet from the lake and forced eight

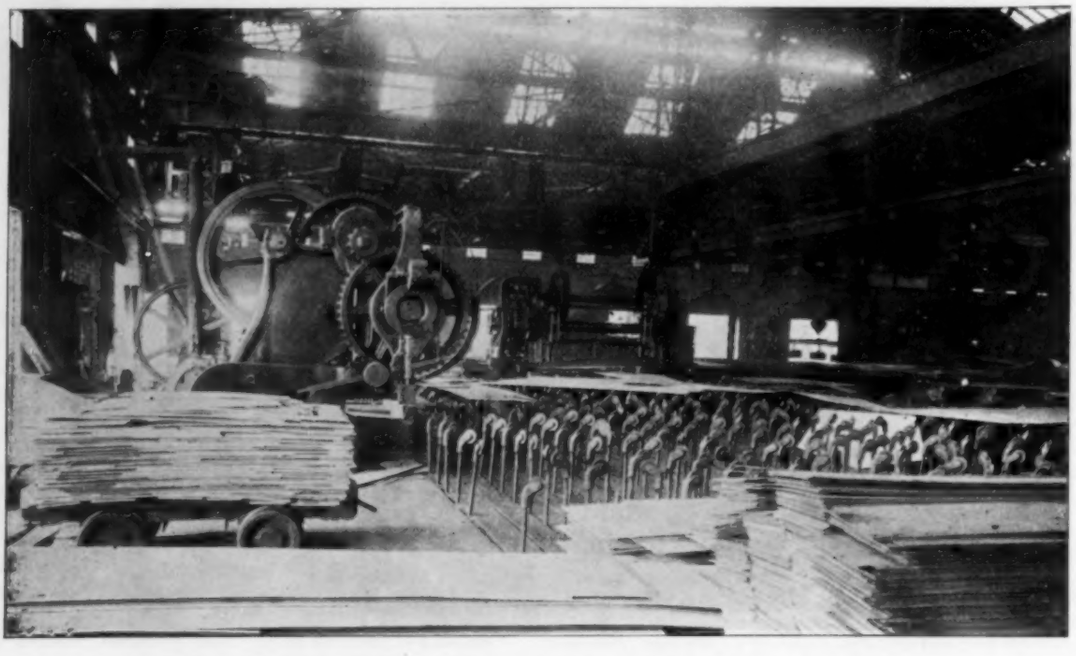


FIG. 9.—SOUTH WORKS PLATE MILL. SHEARING AND SHIPPING DEPARTMENT.

feet, being delivered to a 40-foot tank through a 48-inch pipe. From here it is distributed by compound Worthington pumps to blast furnaces Nos. 5 to 8 plate mill, open-hearth, plant and C. L. S. & E. Ry. shops. The centrifugal pumps are rated at 1,000,000 gallons of water per hour each. There is room for a fourth pump in the station when needed.

Laboratories.

Much care is exercised in securing for use in the various departments only the best materials. Chemical analyses are constantly being made of all raw materials used, of ores, coals, coke, oils, pig iron, ingots, rails, billets, plates, limestones, etc. Precision of work is aimed at and secured.

A branch of investigation but slightly followed in this country and by but few in Europe, is the study of the micro-structure and crystallography of steel and kindred forms of iron in all of the stages of manufacture. An investigation of this nature has been carried on at the South works and developed to a high degree by original investigation in this unexplored field of science by the aid of the best obtainable instruments and methods. This work was begun by A. Sauveur, whose memoirs on the subject in the transactions of the A. I. M. E. and based on the work done here. It is possible by such investigation to determine the chemical composition of iron or steel independently of the chemist, and to discover the heat treatment and comparative rolling temperature of the piece studied, and in that way regulate the reheating treatment.

A well equipped physical laboratory adjoins the plate mill, where all steel is tested before shipment. In this way the strictest requirements of the consumer as to physical and chemical characteristics of material can be faithfully fulfilled.

The Hospital.

A notable feature of this plant is the hospital service given by the company free to its injured employes. The hospital building was completed in 1896, being built with regard to all the requirements of modern surgery. The building is 116 x 28 feet, of pressed brick and brown stone trimmings. It is two stories and a basement high. In the basement are a post mortem room, an ample housekeeping department, hot water heating plant, and room with a large and complete equipment for taking "Roentgen ray" photographs of large size. This permits close watching and inspection of the manner and rate of healings of fractured bones without disturbing them, or inconveniencing the patient by removing bandages or splints.

There are four private wards and two larger wards of 10 beds each. In addition are all the necessary rooms for wound dressing, orderlies, waiting rooms, laboratory and resident physician's apartments. A large solarium in which patients can rest in the sunshine is comfortably furnished. Great care is taken to prevent septic conditions from existing, which would retard recovery of patients.

Location of Raw Materials.

The situation of the plant gives exceptional opportunity for receiving and shipping materials. The Vermilion iron range is but 690 miles distant by rail, so that if desired ore may be shipped in the winter. The works are 1,020 miles from the Mesabi mines. Ore is shipped from this region from the port of Two Harbors. Escanaba, the Lake Michigan port of the Gogebic region, is 490 miles distant, while by rail this range of mines is but 400 miles away. The distance from the Marquette mines is no greater. This ore comes by water from Escanaba, as do those of the Menominee range, which by rail is only 300 miles north of the plant.

Coke, coming wholly by rail, is obtained from the Connellsville region of Pennsylvania and Pocahontas region of West Virginia, distant 525 to 625 miles. Limestone of a very fine quality comes from the company's quarries near Logansport, Ind., 175 miles to the southeast.

In the matter of fuel for steam and gas making, owing to the proximity of the rich Indiana oil fields and the coal mines of Indiana and Illinois, the works are completely independent, for with but a trifling change either fuel can be used. The various boiler houses are equipped for burning either oil or coal. The Bessemer converting works, open-hearth steel works, the rail and plate mills, each have gas producer houses equipped for gas-making from coal. When these are not in use oil is used quite as satisfactorily for steel heating, etc.

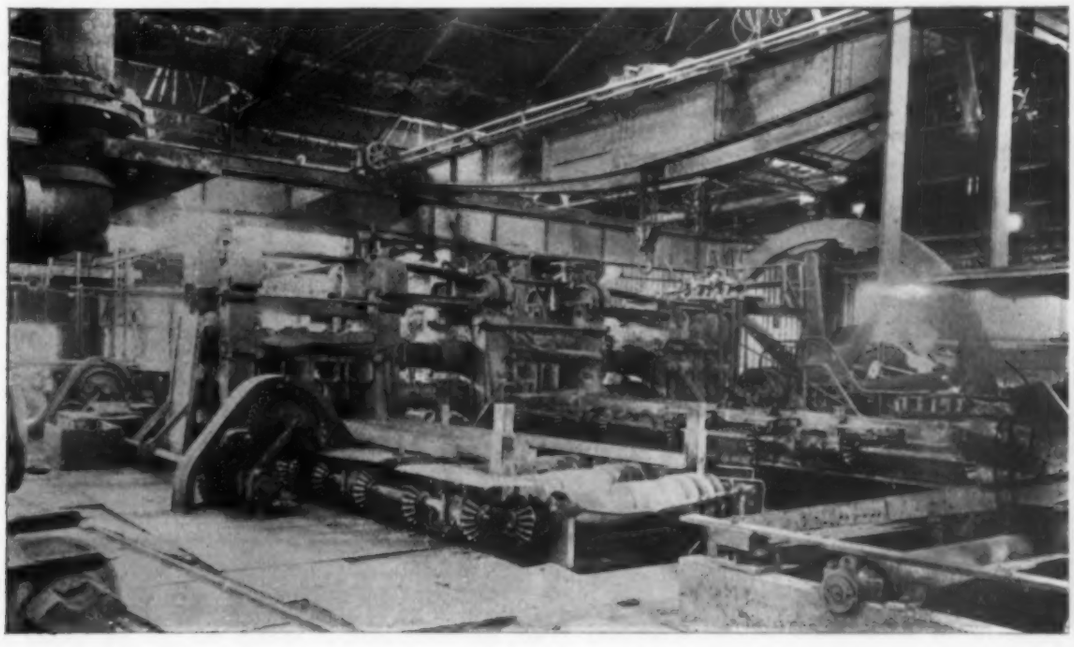


FIG. 10.—UNION WORKS. RAIL MILL.

It is thus possible at all times to work to the highest advantage, and all efforts are made in the direction of large outputs of the best quality of products. This result is arrived at by the largest possible use of mechanical processes—though there are employed in the works about 3,500 men—coupled with the use of the best raw materials and by watching and testing the product at every step of its manufacture.

THE UNION WORKS.

The Union works are situated about five miles up the Chicago River, and within the city limits of Chicago. The plant embraces 55 acres of land and has a river frontage of 2,000 feet. It has direct railroad connections for receipt and shipments of material by rail as well as by water. The buildings are for the most part of the best modern mill construction, being of either brick or iron, and cover a total area of seven acres. Upwards of 15 miles of standard gauge track, besides a complete narrow gauge system, is utilized for the handling of material and storage of cars. The steam and heating plants are equipped for using solid or liquid fuel, as conditions

demand. Crude oil is brought direct to the plant by a pipe line.

The principal products are pig iron, spiegel, steel rails and billets. Bessemer steel has been made exclusively since July 26, 1871, the Union being the pioneer Bessemer steel works in the Chicago district, and among the first in the United States. Rails were the principal finished product until 1892, since which time rails and soft steel billets have been made in about equal proportions. The range of sizes of billets runs from 1¼ x 1¼-inch to 5½ x 5½-inch, in lengths to suit, and of rails from 30 lbs. per yard to 90 lbs. per yard.

The Union blast furnace plant consists of two furnaces, each 73 feet in height, with boshes 15 feet 4 inches and crucibles 10 feet in diameter, capable of producing together 12,000 gross tons per month, and having a maximum daily capacity of 240 tons each. They are equipped with five hot blast stoves, 21 x 52 feet, and two 21 x 60-feet, having 28,000 square feet of heating surface each, which heats the blast to any temperature desired up to 1,600 degrees.

The blast is furnished by four engines built by the Cleveland Shipbuilding Co., having air cylinders 84 x 48 inches, and delivering 306 cubic feet of air at one revolution. A fifth engine is in reserve to be used in case of accident to either of the others. Steam is generated in 16 tubular boilers 72 inches x 20 feet, each boiler having 40 tubes 4½ inches in diameter.

are two molds on each car, and a vertical acting stripper located between the converting works and the rolling mills lifts the molds from the ingots, two at a time, setting them down upon other cars alongside. There is no handling of the molds whatever, excepting at the stripper, and no handling of ingots in the converting works proper. Ample time is thus always afforded for proper setting of the steel after being cast into ingots.

Most of the machinery in this department is operated by hydraulic power. Among the many mechanical appliances which contribute to economy of time and labor may be noted a large overhead electric traveling crane which sweeps almost the entire yard and is employed in handling slags, scrap and other material to be loaded into or unloaded from either standard or narrow gauge cars.

The converting department has produced in one month 36,232 tons of rail ingots, and is capable of maintaining this output regularly if called upon to do so.

The rolling mill department has vertical heating furnaces of the Siemens type for heating ingots. There are four furnaces, each having a capacity of 20 ingots. Each furnace is commanded by a hydraulic crane of five tons capacity. The ingots, which are 16 x 16 inches, are reduced to a bloom of about 7 x 8 inches in nine passes in a three-high blooming mill. This mill has rolls 36 x 87 inches and is driven by a 42

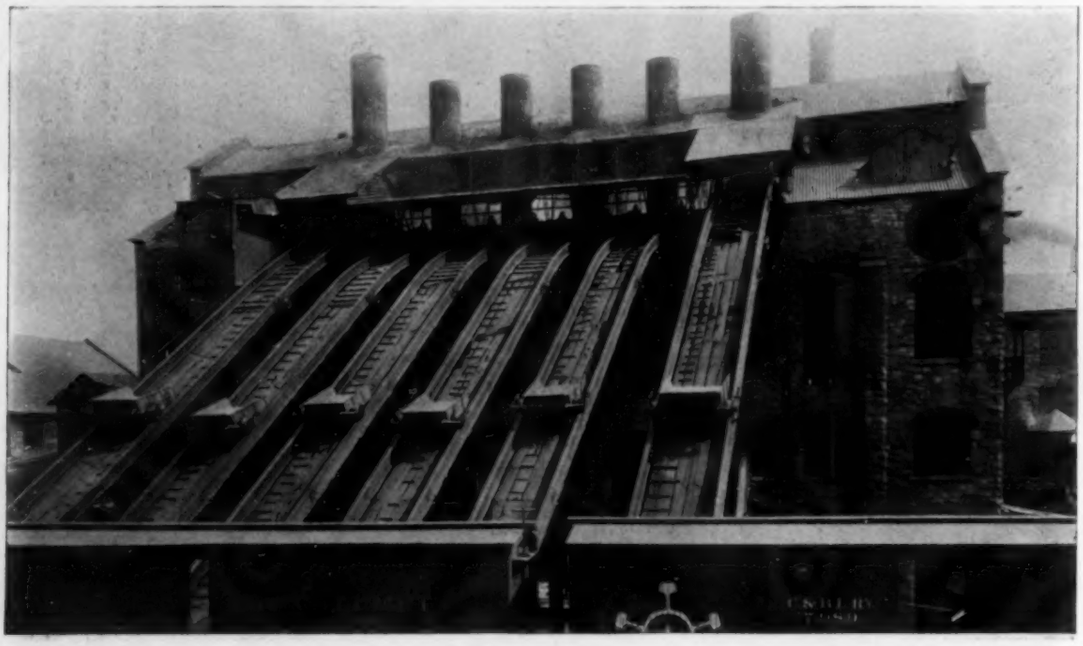


FIG. 11.—JOLIET WORKS. CONVERTING WORKS SKIPS.

One of the furnaces has special appliances in the casting house for casting, handling and breaking the metal. The iron is run into molds about 20 feet in length. The metal is lifted from the molds and carried by means of an electric traveling crane to a roller table which feed the long bars through a breaker. The breaker is placed at such an elevation that the broken pieces fall by gravity into cars placed alongside of the casting house. The metal cast in this manner is free from sand and of uniform size, enabling it to be used with the greatest economy.

The present converting works were built in 1885 and almost entirely remodeled in 1895, making them to-day as well equipped for the manufacture of Bessemer steel ingots as any modern American mill operating under the indirect process. This department embraces a melting plant of five 10-foot iron cupolas, each having a melting capacity of about 150 tons in 12 hours, and four 5-foot spiegel cupolas, and two 10-ton Bessemer converters in which a maximum of 78 heats have been blown in 12 hours, producing 850 tons of rail ingots. Blast for the cupolas is furnished by seven No. 10 Sturtevant pressure blowers and blast for the converters by three vertical direct blowing engines having air cylinders 80 inches diameter by 48-inch stroke.

The steel is cast into molds which rest upon cars. There

x 72-inch direct coupled engine. Blooms are rolled direct into rails or billets, after having the ends cropped, in a three-high train of rolls. This mill has two stands of rolls each 25 inches diameter by 66 inches long, and is driven by a 44 x 66-inch direct coupled engine.

Both the finishing mill and the blooming mill are equipped with automatic tables for manipulating the bars and every operation throughout the mill is performed by machinery especially designed for the purpose.

Although blooms are usually rolled direct without reheating, a large furnace is provided for heating them when necessary. Each ingot is cut into two blooms and these blooms are rolled into single lengths from 65 feet to 95 feet. After leaving the rolls the rails are sawed into lengths of 30 feet and then delivered on cooling beds where they are allowed to thoroughly cool before being passed into the finishing building. From the time the steel enters the mill until it is passed into the finishing house absolutely no hand labor is performed directly upon it, thus gaining every advantage of speed and regularity of operation which machinery can contribute.

The finishing department has eight straightening presses and the same number of drill presses. Although finishing goes on day and night, all inspection and shipments of rails are done during the hours of daylight.

Billets below 2½ inches square are usually made into 30-feet lengths. Above that size they are cut, while hot, into any desired length down to 12 inches. The cutting is done with a duplex hydraulic bloom shear capable of cutting six 5 x 5-inch billets. As the billets fall from the shear they drop on a roller conveyor which elevates and conveys the billets out over the billet yard a distance of some 600 feet from the rolls. For a distance of 350 feet the conveyor has an elevation of 25 feet above the yard level. Switches are provided at distances of 12 feet on either side for discharging the billets on the ground or into elevated hoppers. The billets which are discharged into the hoppers are dropped directly on cars after being allowed sufficient time for cooling, thus doing away with all labor in handling this class of product.

The rolling department embraces a finely equipped shop for turning rolls. There are four roll lathes, each driven by separate electric motors and improved tool-grinding machinery, driven also by a separate motor. The gas-producing plant consists of 20 Wellman producers. Steam is furnished by 14 72 x 20-inch and 19 54 x 28-inch tubular boilers. The plant has its own shops for making repairs and constructing special machinery used in the various departments. There is a complete electric power plant and also an electric light plant for both incandescent and arc lighting.

NORTH WORKS.

The oldest plant connected with the Illinois Steel Co. is the North works, which was started in 1857 as a mill for re-rolling iron rails. The manufacture of wrought iron, however, has long since been discontinued. The old puddling mill has been converted into a plant for the manufacture of cement. The products of this plant now consist of pig iron, steel structural shapes, bridges and steel Portland cement. The plant is situated on the north branch of the Chicago River, in the northern part of Chicago, and comprises two blast furnaces 16 x 65 feet, a Bessemer plant with two six-ton vessels, a 30-inch three-high blooming mill and a 23-inch three-high finishing mill.

The furnaces were originally built in 1869 and equipped with pipe stoves, which have been replaced by fire brick stoves of the Gordon and Massick and Crookes type. The ore for these furnaces is brought by vessel from the Lake Superior mines and is laid directly on the company's docks on the river bank within wheeling distance of the furnaces. The product of the furnaces is both foundry and Bessemer pig iron. All of the iron is run into pigs, as a large portion of the product of these furnaces is shipped to other plants.

The Bessemer plant was built in 1872 on designs of A. L. Holly, and in addition to the six ton vessels mentioned above has five cupolas for remelting pig iron, three spiegel cupolas, a ladle crane and three ingot cranes—all arranged on the Holly or American plan, with horizontal blowing engines, hydraulic pumps, etc. At the time of its construction this was the most complete Bessemer plant in America, and for a plant of its relatively small size has done remarkably good work.

Notwithstanding the age of the plant, it is still capable of giving a good account of itself. The product until 1890 was used entirely for steel rails. Since that time, however, rail-rolling has been discontinued at the North works, and the finishing mill changed into a beam mill. It is worthy of note that this is the only mill in the West rolling beams and channels up to and including 15-inch. The mill is capable of handling a product of 250 tons of finished beams or other structural shapes every 24 hours. It is equipped with hot and cold saws, straightening presses and all modern appliances necessary to handle the product in an economical manner.

The first steel rails made in America were rolled in this mill May 24, 1865, from blooms made at the experimental Bessemer works at Wyandotte, Mich.

In connection with the fitting shop the company is prepared to turn out a complete bridge or steel structure, direct from the ore, as there are facilities on the premises for all of the intermediate operations. The fitting shops are equipped with all modern appliances for punching, assembling and riveting steel structures, and have a capacity of over 1,000 tons of finished material per month. These shops have recently been leased to the Universal Construction Co., Inc., and are at present operated by that company. Numerous office buildings, power-houses, United States Government and State buildings and public institutions, viaducts and other structures, some of which combine an ornate appearance with simplicity of construction, attest the excellence of the work which has been turned out in the past years.

The Universal Construction Co. carries in stock a large tonnage of all structural shapes, so that local trade demands are filled on short notice.

CEMENT PLANT.

At the North works, besides pig iron and structural steel, a brand of hydraulic cement of the highest quality is manufactured. The basis of this material is slag from the blast furnaces, and the process is strikingly simple.

The slag as it comes from the blast furnace flows into an open trough which terminates above a large tank of water. Immediately below the end of this trough is a nozzle, connected with a steam pump capable of throwing a large body of water against the stream of molten slag at a pressure of 80 pounds per square inch. This contact between the slag and the cold water not only causes the slag to break up or granulate, but changes it chemically in such a way as to render it suitable for the manufacture of cement. The chilled slag is then conveyed into the rotary dryers where it is deprived of all its moisture, and thence passes before a powerful electric separator and any metallic particles which may be chemically held eliminated. The material is then fed to a suitable grinding machine where it is reduced to such a degree of fineness that 90 per cent passes through a sieve containing 80 meshes to the lineal inch, after which it is conveyed to large hoppers situated over the tube mills. These tube mills accomplish two purposes: Grinding the material to a degree of fineness unprecedented in the making of cement materials, and at the same time intimately mixing the various ingredients of the cement. In the present plant there are four of these tube mills. They consist of horizontal cylinders about four feet in diameter and 16 feet long, lined with porcelain tile and containing about one-half their volume of flint pebbles. These pebbles are collected on the seacoast of Norway, are egg-shaped and vary in size from two inches to an inch in diameter. The mills make about 27 revolutions per minute and the grinding and mixing is effected by the continuous rolling of the pebbles within. The slag and previously prepared lime and other ingredients are delivered to the mill through a trunnion at one end and come at once into contact with the pebbles and travel the length of the cylinder until discharged from the periphery at the other extreme.

The fineness of the product varies with the amount of material fed into the mill within a given time, and as this is entirely under control, the product may be brought to any degree of fineness desired In fact, upon this one point the high quality of the cement is very largely dependent, and no product is shipped which is not so fine that at least 95 per cent of it will pass through a standard sieve containing 40,000 meshes to the square inch. The material which comes from the tube mill is the finished cement. It is packed mechanically into barrels and bags for the market, emerging under the trade name of "Steel Portland Cement."

While cement has been manufactured in European countries out of blast furnace slag for many years, little has been put upon the market that has not been open to severe criticism. This has been mainly due to two causes: first, its irregularity, and second its slowness in setting. The first difficulty arises chiefly from the fact that the slags of Europe are of themselves not at all of a uniform composition, the ores from which they are made being of very low grade. With the Illinois Steel Co. the process of manufacturing its cement begins at the ore mines and not at the blast furnaces. Its ores are selected from the purest and most regular mines in the world and great care is taken to use only those which will produce a slag of uniform character and of a composition best suited to the manufacture of cement. Before the slag is used each lot is submitted to the most careful analysis and all material not of the correct composition is absolutely discarded. The second difficulty, that of slow setting, is overcome by patented as well as secret improvements in the process, making it possible to control the time of hardening of the finished product so that it will fulfill the requirements of almost any class of work. It will be noticed, therefore, that though the

process is somewhat similar to that employed abroad, still it differs from it in very essential details and the resulting cement is a much superior article.

Although a comparatively new brand on the market, steel Portland cement has already been placed in much important work. It is being used on a great many of the railroads tributary to its market, in large and important buildings in Chicago and elsewhere, in bridges and in heavy concrete work of all kinds. It is also being taken up extensively for laying limestone, marble and other light colored building material for the reason that it is stainless, a quality possessed by few cements.

The present capacity of the plant is about 300 barrels per day, but so great is the demand for the material that the erection of a new plant of a much greater capacity is contemplated in the near future at one of the company's other works.

MILWAUKEE WORKS.

Milwaukee works, although not to be compared in size with South works, are still a very important part of the make-up of the Illinois Steel Co. The plant is located in Milwaukee, on the shore of Lake Michigan.

At the present time the plant consists of two blast furnaces one puddle mill, one splice mill, two rail mills and five merchant trains, one 21-in, one 12-inch, two 9-inch and one 8-inch. The annual consumption of ores and other furnace materials when at full capacity is 450,000 tons, and of steel billets and other mill stocks 350,000 tons. The producing capacity is 397,000 tons, divided as follows:

Angle and splice bars	72,000 Tons
Light rails	90,000 "
Bar iron and steel	75,000 "
Pig iron	130,000 "
Miscellaneous	30,000 "
Total	397,000 "

The works cover an area of 62 acres, besides which there are 96 acres of lake front, at the north end of which are situated the ore and shipping docks.

Ore Docks.

In 1896, entirely new machinery was placed at the ore docks. This is now driven by an engine of the company's own make, with two boilers of 60 h. p. each, running two hoists, one of six hacthes and one of three hatches, capable of hoisting 5,400 tons of ore in 24 hours. The business of shipping by lake is becoming an important one at Milwaukee works, and dock provision has been made for handling a very large tonnage of the Milwaukee product to be shipped direct to seaboard, as well as to take advantage of low water rates to Canada and Southeastern points. Through this water connection, railroad facilities have been increased from the two railroads which connect directly with the works, by the five or six boat lines running out of Milwaukee, which bring and take material from the docks daily.

Blast Furnaces.

Milwaukee works have two blast furnaces, No. 1 and No. 2, each having a bosh diameter of 16 feet and an altitude of 66 feet. The hearths are 9 feet 6 inches in diameter. Each furnace has three Massick & Crooke's stoves, 18 feet in diameter and 60 feet high. There are four upright engines used, the steam cylinder of each being 38 inches in diameter. The air cylinder is 84 inches in diameter, with a stroke of 54 inches. One duplex hoisting engine is used to hoist the ore, coke, limestone, etc., to the top of the furnaces for charging. Each furnace has a cast house 50 x 120 feet. The product of these furnaces is principally foundry iron for the trade, the varieties made being called by the names of Bay View Foundry, Gertrude and Bay View Scotch, in addition to which a considerable tonnage is made of low phosphorus iron for malleable purposes, and a varied amount of basic for open-hearth furnace use. The total capacity of the furnaces is about 130,000 tons per annum.

Merchant Mills.

The merchant mill building had originally brick walls with steel frame and corrugated iron roof and contained three small trains, the 12-inch, 9-inch and 8-inch. It has since been found necessary to increase the size of the building so that at present it is 715 x 195 feet in size and covers six trains, which include a new 22-inch mill erected in 1896, a 21-inch mill, which was entirely remodeled in the same year, a 12-inch, the old 9-inch and 8-inch mills which have also been improved and practically reconstructed since originally built, and a new 9-inch train erected in 1890, which is of modern pattern and compares favorably with other mills of its class.

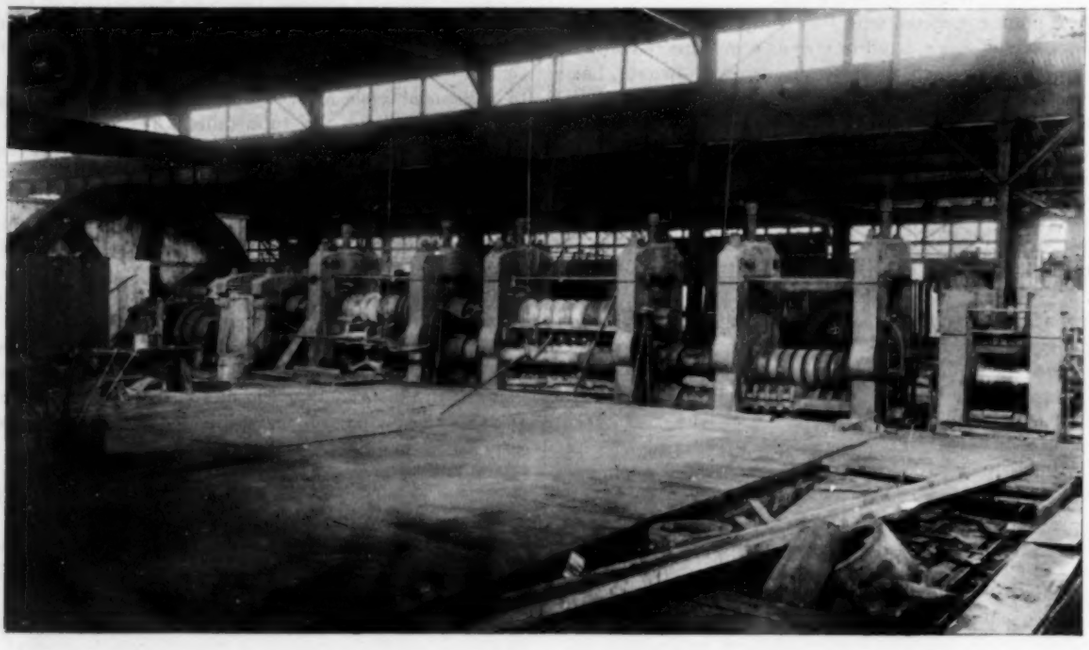


FIG. 12.—MILWAUKEE WORKS. MERCHANT MILL.

The 22-inch mill has just been re-arranged for the production of light rails, a furnace having been erected 14 feet by 21 feet 6 inches, being equipped with an automatic pusher, charging and drawing machine, by which long lengths can be handled easily and cheaply. The roll train is of a late pattern and is driven by a Ranken & Fritsch 42 x 48-inch horizontal engine, have a 20-foot fly-wheel weighing 68 tons. Rails can be rolled on this train from 12 to 45 pounds per yard, with an average capacity of 5,000 tons of product per month. This mill is equipped with a Pawling & Harnischfeger electric traveling crane, which operates also over the 21-inch train, making the changing of rolls and lifting of other heavy articles easy of accomplishment.

The 21-inch mill has two heating furnaces, 8 x 16-foot hearth. The engine is a mate to the one in use on the 22-inch mill, having been erected at the same time. This mill produces

shafting sizes from 2 inches to 6 inches and flats 3 x 1 inches to 8 x 2 inches, plow beam billets and other varieties of steel bars, and has lately been equipped with rolls, punch machinery and carriers for the purpose of producing angle and splice bars. The tonnage of this material varies according to the sizes being rolled, but the mill has a record of 140 tons of angle bars in 24 hours, which is at the rate of 3,500 tons per month.

The 12-inch train has two heating furnaces and a roll train of five stands of housings, the rolls being driven by an engine 28 x 30 inches, running 135 revolutions per minute. The product of this mill is bar steel in sizes from one-inch to two-inch rounds and squares, and flats from 1½ x 1½ inches up to 3 x 1 inches. The capacity of this mill is 2,000 tons per month.

The No. 1 9-inch mill also has two heating furnaces and a 26 x 25-inch engine, running 190 revolutions per minute, driving five stands of rolls and producing rounds from ½ inch to about 1¼ inches and flats up to 2½ x ⅝ inches. The No. 2 9-inch mill has two heating furnaces of the same size as those on the 12-inch mill, the roll train being driven by a 20 x 24-inch engine running 250 revolutions per minute.

The 8-inch mill is run by an engine 22 x 36 inches, running 100 revolutions per minute, the train being connected by a 38-inch belt to a band wheel 14 feet 6 inches in diameter. The mill has two furnaces 6 x 10 feet hearth, and runs on sizes from ¼ to ¾-inch rounds and flats up to 1½ x ⅜-inches. The combined capacity of these four trains is about 6,300 tons per month, quite a large portion of which is made up in the form of steel angles, which are cold straightened by roller straighteners of the company's manufacture, cotton ties, etc.

The steam for these departments is produced by two batteries, a total of 16 boilers each 6 x 20 feet, with 50 4½-inch tubes. The fuel used is oil. A Nordberg steam condenser is attached to the 12-inch and No. 1 nine-inch engines, reducing largely the need for high pressure of steam for these two machines.

Fish Plate and Plate Mills.

The two trains located in the original rail mill buildings are the 18-inch and old 22-inch mills, having a production of about 5,000 tons per month. Attached to the 18-inch train is a department for making Servis Tie plates, for which there is at present a large demand.

Puddle Mill.

With the increased consumption of steel, the puddle mill has been abandoned.

Water Works.

This plant has its own pumping station. The total pumping capacity of the works is 200,000,000 gallons per month.

Other Equipment.

The electric light and power plant is located in the merchant mill building, and is made up of one engine 14 x 16 inches, running 250 revolutions; one engine 10 x 24 inches, running 120 revolutions; one 150 h. p. Westinghouse generator, one 40 arc light Thompson & Houston-machine and one 40 arc light Wood machine. Arc lights from these machines are located all over the plant, making the customary night work easy of accomplishment. Power from this generator is used in running the traveling crane over the 21-inch and 22-inch trains, and when coal is used for steam purposes power is furnished to a Brodesser coal conveyor which brings the fuel from the stock piles in the outer yard and dumps it directly in front of the boilers.

The roll shop is an important department at Milwaukee works, there being a large number of sets of rolls which have to be kept in good condition, necessitating the use of eight roll lathes, which are kept running night and day. The machine shop, though not as large as might be expected on account of the great number of machines about the plant, is well equipped to take care of all the machine work required, and is fitted up with lathes, planers, bolt cutters, knife sharpeners, pipe-threading machines, etc., and is in condition to do the work at low expense. The blacksmith shop, carpenter and pattern shop are also a part of the outfit.

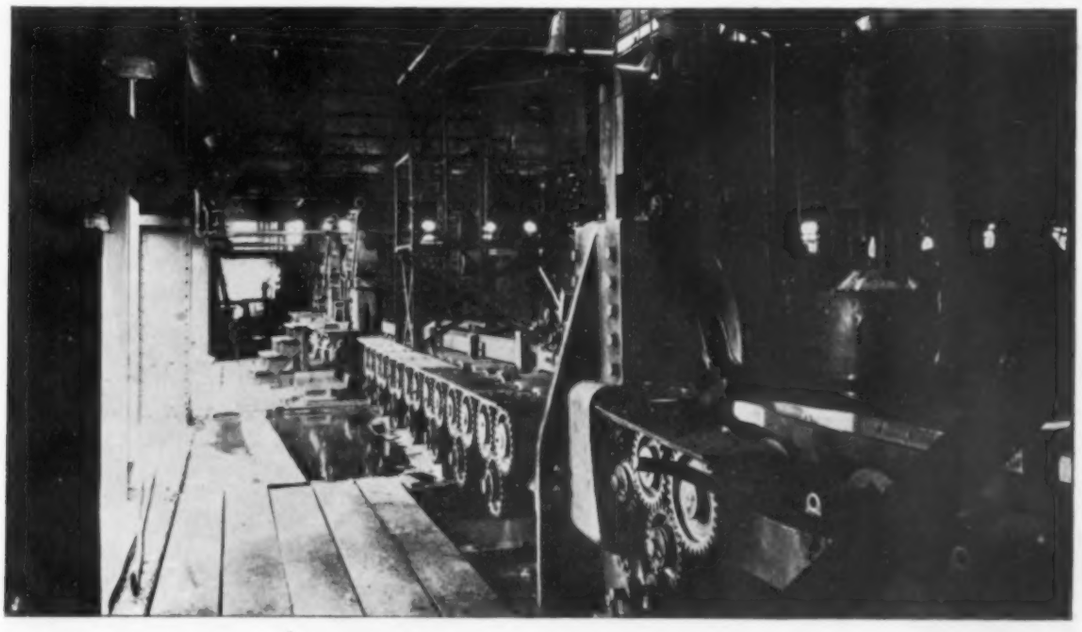


FIG. 13.—JOLIET WORKS. ROD MILL SHEAR.

The company also employs a force of boilermakers and masons, so that practically all the work of repairing the plant and keeping it in order is done by men regularly engaged by the company, very little of it going to outside concerns.

Attached to the blast furnaces is a small but well equipped laboratory which covers the work of analysis of the regular casts of pig iron, as well as all samples of ore, coke, etc., received, and also analysis steel when found necessary or desirable. As a great deal of the pig iron manufactured here is sold for foundry purposes, shipments being made based upon analysis, it will be seen that this is quite an important part of the work.

JOLIET WORKS.

The Joliet plant was started as an iron rail mill in 1870 A. Bessemer works and steel rail mill on Holley's designs were added in 1873. Two blast furnaces were built in 1873, the steel works were remodeled in 1885, a Garrett rod mill was built in 1888, a third blast furnace was completed in 1890 and a second rod mill and a merchant mill in 1895. It will be seen that the works have been greatly changed with the passage of time. No rails are now rolled at this plant, the product consisting of billets, tin plate bars, wire rods, angles, merchant bars, railway spikes, etc. The railroad connections are very good. Not only do some of the great trunk lines pass

through Joliet, and even through the company's yard, but one of Chicago's belt lines, known as the Elgin, Joliet & Eastern Railroad, connects with all roads running from Chicago in any direction. The property comprises in all 95 acres.

Blast Furnaces.

The Joliet blast furnaces vary in size and equipment. No. 1 is 80 feet 10¾ inches in height and 20 feet in diameter at bosh; No. 2 is 79 feet 4 inches by 20 feet, and No. 3 is 78 feet 6 inches by 19 feet 6 inches. No. 1 has four Gordon-Cowper-Whitwell three-pass stoves; No. 2 has four Whitwell four-pass stoves with Foote lining, and No. 3 has four Massick & Crookes three-pass stoves. Nos. 1 and 2 are together blown by five Cuyahoga engines, 40 x 84 x 54 inches; one single Allis-Corliss, 40 x 84 x 60 inches, and one double Allis-Corliss, 36 x 76 x 54 inches, with an ordinary limit of 35 to 40 revolutions per minute and 40 to 50 in emergency. No. 3 is blown by three Allis-Corliss single non-condensing engines, 40 x 84 x 60 inches, with a speed limit of 35 revolutions per minute. Steam is supplied at Nos. 1 and 2 by 20 boilers, of which 12 are 6 x 20 feet, with 50 4½-inch tubes; two are 5 x 21 feet, with 50 4½-inch tubes; four are 250 h. p. Heine safety water tube, and two are 250 h. p. Cahall safety water tube. No. 3 is supplied with steam by 10 boilers, of which two are 66 inches by 23 feet, with 44 4½-inch tubes. All are fired with waste gas from the furnaces. Vertical hoists are used, which are operated by Crane automatic engines. The water supply is obtained from the canal nearby and from an artesian well, being distributed by 19 pumps of various makes and capacities. Furnaces Nos. 1 and 2 have a common stock house 85 x 250 feet, and No. 3 has one 90 x 180 feet. Nos. 1 and 2 have a casting house 100 x 120 feet, covered, and two beds 60 x 60 feet, open. No. 3 has a casting house 44 x 210 feet, covered, and two outside beds 44 x 54 feet. All furnaces are fitted for handling liquid metal direct in ladles. Cinder is taken from all furnaces by Weimer cars. The capacity of the ore yard, including stock houses, is approximately 275,000 tons.

FIG. 14.—JOLIET WORKS. END OF CONTINUOUS TRAIN.

Bessemer Converting Department.

The Bessemer plant consists of two 10-ton converting vessels and six cupolas. Four cupolas are nine feet in diameter and two are 11 feet. The cupolas, instead of being charged by hand, have an incline track from the pig iron yard to the charging doors of each one. Small cars or skips run from the yard to the cupolas on these tracks and dump automatically into the cupolas. A small reversing engine on the charging floor pulls them up by cables.

The pig iron is obtained from the furnaces at Joliet, together with some from the other works of the Illinois Steel Co.

Standing back from the vessels are two ladles to receive the cupola metal. Three cupolas are tapped into one ladle and three into another, each vessel being served by a separate laddle. The ladles are lines with loam and last about 80 heats before relining and patching. They are turned down and emptied by mechanical power. The cupolas can ordinarily supply the vessels, but when only five cupolas are operated, molten metal is brought directly from the blast furnaces in such quantities as may be necessary. This is easily managed, as the ladle may be run directly behind the converters.

The vessels are served by a 20-ton hydraulic ladle crane, all its motions—vertical, swinging and racking—being by hydraulic power. In the mill proper, there are four more 10-ton hydraulic cranes for handling ladles, molds, scrap, etc., besides one in the bottom house and one in the steel ladle house.

The heats are poured on cars, six 16-inch ingots being used. Molds are made in the company's foundry. The cars are taken to a stripper house 460 feet from the converting house. Here are two stripping machines designed by Henry Aiken, which strip the molds from the ingots, the cars being moved by hydraulic cylinders into proper position to have one mold removed at a time.

The fan room for the cupolas has five No. 8 Baker blowers, two No. 10 Sturtevant blowers and one No. 8 Sturtevant, operated by a 22 x 42-inch Bates-Corliss engine. The blowing engines for the converters combine a Southwark cross compound vertical condensing engine, 32 x 60 x 48 inches, fitted with automatic gridiron valves on the air cylinder which is 80 inches; one Allis double vertical condensing engine, with steam cylinders 32 x 54 inches, and air cylinders 48 x 54 inches, fitted with poppet valves on air cylinders; one I. P. Morris double vertical non-condensing engine, with steam cylinder 42 x 54 inches and air cylinder 58 x 54 inches, held in reserve. The boilers are 17 in number, consisting of 13 tubular and four Heine. Duff, nut, lump, pea and screenings are used for fuel.

Ordinarily only soft steel is made at this plant, but from time to time steel with carbon varying from .10 to 1.00 is made. Records in this department are as follows:

Best 24 hours, 1,997 tons, made March 31, 1896.

Best month, 41,597 tons made in March, 1896.

Billet Mill.

There are five Siemens regenerating heating furnaces to which the ingots are delivered after stripping. Three of these furnaces are 48 feet long and two 28 feet, having a combined capacity of 48 ingots. They are served by two Wellman electro-hydraulic charging and drawing machines. These machines run on a track of 18 feet gauge in front of the furnaces, leaving room however for a narrow-gauge track immediately along the furnaces for the passage of a buggy hauling ingots, the charging machines taking the ingots from the

buggy and placing them in the furnaces, or vice versa. Oil is used entirely for heating. The furnace doors are raised and lowered by air pressure. The ingot is drawn and placed on a small buggy which is moved in front of the furnaces by cable, from this buggy the ingot is delivered to a roller passing between the furnaces and delivered to the blooming mill.

The blooming mill is a three-high train, 90 x 36 inches, in which the ingot is reduced from its cast section of 16¼ x 16¼ inches to a 6 x 7½-inch bloom, 11 passes being made. The bloom table is manipulated by hydraulic power; this handles the ingot and bloom, turning them over and directing them into the proper passes. After being bloomed the piece is cut into lengths to suit the various finishing sections at the large blooming shears.

The roughing or billet mill is a three-high 25-inch train and is served by a system of troughs and tables which are operated by hydraulic power and carry line rollers to move the piece to and from the rolls. This mill can roll from 3½-inch to 6-inch squares and from 4¼ x 2½-inch to 8¼ x 2½-inch slabs. From here the pieces that are not delivered to the finishing train travel to the billet shears and are cut into the desired length for shipment. The shears are double, being operated by a hydraulic intensifier, and cut two billets at a stroke. After shearing the billets or slabs are carried up an incline and out of the mill by a roller chain conveyor, from which the various lengths can be switched off to fall in the yard, or can be carried directly to the rod mill furnaces. At another point in this conveyor a chute leads directly to the merchant mill roughing train, so that a finished half-inch round can be rolled directly from the ingot without reheating. Directly under the hot billet conveyor is a similar one at the ground level, on which are placed the cold billets which are carried directly to cars for shipment. The billet conveyor is driven by a No. 1A 25 Gibbs electric motor of 50 h. p.

The finishing or bar mill is a three-high train and is served by the trough system without tables. The billet before finishing is delivered by a trough from the roughing mill. Bars from 60 to 120 feet in length are rolled and cut by hot saws into 30-foot lengths. From these are rolled splice bars, merchant angles, sheet bars, both square and taper edge; bars from 1 5/16 to 3 inches square, flats from 2¼ x ¾ inches to 4¼ x 2½ inches, and three-inch rounds. The train is driven by an Allis horizontal condensing simple engine, 40 x 60 inches, 1,200 h. p., at 100 lbs. steam pressure.

Independent engines of various makers operate the blooming mill tables, the ingot run, the bloom run, shears, roughing mill tables, saws, etc. Steam is supplied by 22 boilers, of which 20 are tubular and two are Heine water-tube. Water is supplied for all purposes by nine pumps, principally duplex. An Ingersoll-Sargent air compressor delivers 500 cubic feet of air per minute.

An addition to the billet mill consists of two shops for finishing angle bars. These shops are both fitted with Long & Allstatter tools and turn out work of the finest finish.

Merchant Mill.

This mill, located in a special building, consists of a simple Belgian train having two stands of 18-inch roughing rolls and seven stands of 12-inch finishing rolls. Although the mill is served by two Siemens regenerative heating furnaces, yet a large proportion of its product is finished without reheating the billet; that is to say, the billet is received from the conveyor, direct from the billet mill, and rolled at its initial heat. Half-inch merchantable rounds and heavier sections have been made successfully by this process.

The rolls are driven by a single horizontal Wheelock engine, 36 x 60 inches, geared directly to the 18-inch rolls and by rope drive to the 12-inch rolls. Two Crane double reversing engines run the roller table in front of the hot bed. Steam is supplied by six tubular boilers.

The products of this mill are merchant sizes of rounds, squares, flats, etc. A large part of the product of the mill is consumed in the bolt and spike factory in the same building. Steel track bolts and nuts, rivets and railroad spikes are made here.

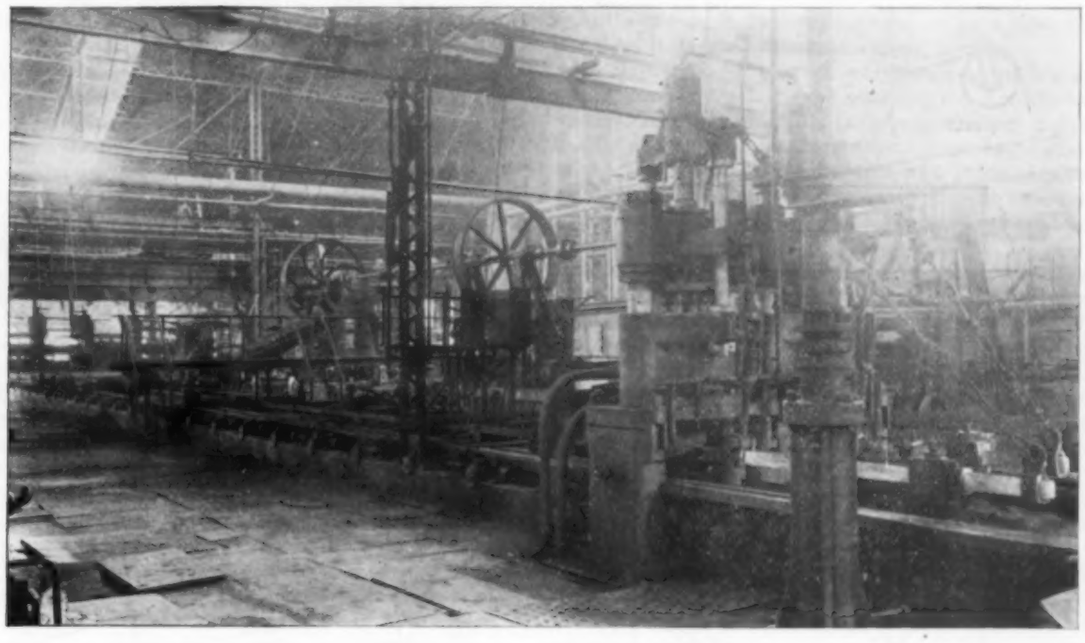


FIG. 15.—JOLIET WORKS. BILLET MILL SHEAR.

Rod Mill.

This mill consists of two typical Garrett mills, both being fed, in place of the regular roughing train, by a continuous train which is in turn served by four continuous heating furnaces. The continuous train has six stands of 18-inch rolls, arranged in the center of the building with the rod trains on the right and left, while the heating furnaces are on the side toward the billet mill.

The billets drop directly from an overhead traveling conveyor, as they come from the billet mill, on a storage table from which they are fed automatically into the continuous furnaces, while still at a red heat. They are pushed rapidly through the furnace, where they receive a wash heat, are pulled out and delivered to the rolls. Each billet, weighing about 300 lbs., is cut in half before reaching the continuous train, each half being finished separately. A device for distributing billets between the two rod mills is situated between the hydraulic shear and the first train of rolls. The six passes of the continuous train and the first three passes in each of the Garrett mills are made without the bar being touched by an operator or tongsman. From this point the usual practice in the Garrett mill is carried out in detail.

The size of the heating furnaces is 50 x 8 feet, inside measurement, and they are fired with oil. The billets are pushed

through by hydraulic power, applied at the ends, but are drawn at the sides by drawing machines operated by compressed air. These machines are each managed by a workman seated in a chair on the device, who transfers the heated billets to a continuous runway of 18-inch rollers 100 feet long, passing under the vertical billet shear to the continuous rolls. In these rolls are five identical passes, in which as many billets can be rolled at once. The rolls are speeded proportionately with the elongation of the rolled bar, and at the last pass deliver 1¼-inch square bars through troughs to the rod mills on the right or left, or to hot beds straight ahead. The rod mill on the left, or old mill, has one stand of 16-inch rolls, three stands of 12-inch, four stands of 10-inch and four stands of 9-inch. The rod mill on the right, which is the new mill, has one stand of 16-inch rolls, three stands of 14-inch, four stands of 11-inch and four stands of 10-inch. Sloping standings are arranged on the outside of each finishing rod train. Six cone rolls at each mill coil the finished rods into bundles, drop them on a conveyor below, from which they are caught at a certain point by overhead hook conveyors which carry them to the loading docks.

The continuous train is driven by a 3,000 h. p. Porter-Allen horizontal condensing engine, 54 x 66 inches. The old rod mill is run by a 1,300 h. p. Porter-Allen single horizontal engine, 32 x 48 inches, and a 2,200 h. p. Allis tandem compound horizontal engine, 36 x 64 x 60 inches. The new rod mill is run by a 2,200 h. p. Wheelock horizontal single condensing engine 42 60, inches, and a 1,300 h. p. Wheelock single horizontal engine, 36 x 48 inches. The Wheelock engines have rope drives, while the others are connected direct or by bevel gears or belts. Steam is supplied by 41 tubular boilers, mainly 6 x 22 feet, with 50 4½-inch tubes. All are coal fired. The water system keeps 12 pumps in service.

The capacity of the mill is 18,000 tons monthly.

Miscellaneous.

The plant includes a roll shop with an equipment of 10 lathes; a machine shop, smith shop, boiler shop, carpenter shop, pattern shop, foundry with two cupolas, one 12 to 14 and the other 10 to 12 tons per hour; an air furnace of 18 tons capacity and two brass furnaces. The electric lighting and power plant has three generators and six dynamos, operating 10 motors in various parts of the works, 133 arc lights and 957 incandescent lamps.

NEW PATTERNS OF SAND-SIFTING MACHINERY.

The writer has recently been engaged in getting out several new styles of sand-sifting machinery for foundry use, and thinking that some of the types may be useful for your readers to adopt (they are not patented), I herewith hand you drawings and descriptions of the same. In Fig. 1 is a type of sand-sifter which I erected at small cost, using odds and ends from about the shop and have found the device to be very serviceable. The cradle was one formerly used on a sifter which had been cast aside. I put the toothed plate-pieces B B on either side, and arranged for upright half-gears A A, to mesh in with the cogs, as shown. The entire weight of the cradle is upon this geared motion. Now it is only necessary to employ a movement that will cause the sand to sift, and this is done by putting a connecting rod D between the shafts of the half-gears and the stud on the wheel E. This wheel is driven by the belt and the over and over motion communicated to the half-gear shafts, and the cradle is rocked in a manner that differs from the ordinary way, and at the same time gives the sand a thorough shifting through the screen bottom, whence it falls out at C, striking upon the sides F F, and going to the floor through G.

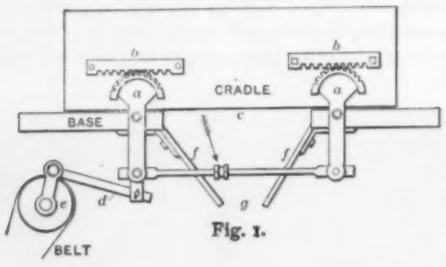


Fig. 1.

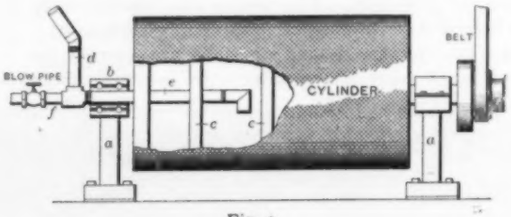


Fig. 4

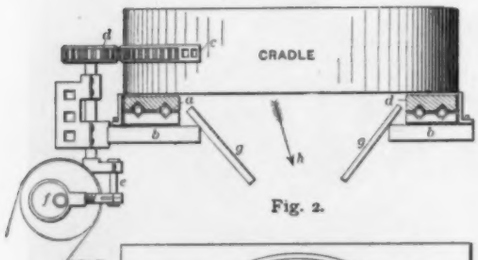


Fig. 2.

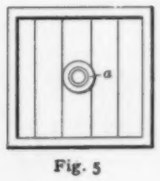
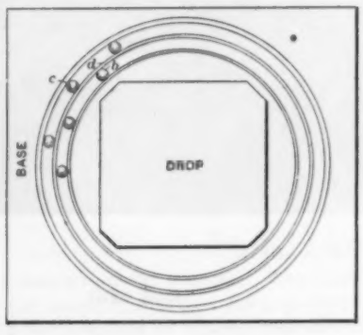


Fig. 5

Fig. 6

Fig. 7



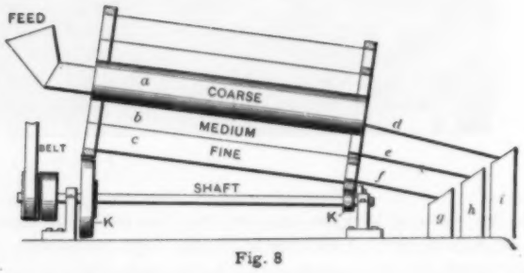


Fig. 8

NEW PATTERNS OF SAND-SIFTING MACHINERY.

The plans for building the novel sifter shown in Fig. 2 were furnished me by a man long skilled in foundry work. He is pleased to term the arrangement an eighth-motion machine, as the cradle shifts on a level base to the extent of one-eighth its circumference.

I first built a base, B B, and upon this base put a race-way for a series of balls, so as to run the machine on the ball-bearing plan. The race-way on the base and the ball casing on the bottom of the cradle are V grooved, as may be seen in section at A A. A strip of toothed iron casting is set screwed to the cradle at C and the gear D fixed up to engage with it, as shown. An eccentric cam at F is keyed on the driving shaft, and the latter run by the belt. This eccentric cam operates the arm which is connected with the stud at E, and as the latter is on the shaft with the gear D, the necessary motion is given to the cradle, which is a circular movement one-eighth each way, the shifting resulting in the sifting of the sand through the wire screen bottom, through H, and guided by the slide pieces G G. A top view of the base and ball race-way, showing the balls C, B and ridge A, is shown in Fig. 3.

Some of the users of the COCHRANE HEATERS, in the Iron Industries, Pittsburg Section.

National Foundry & Pipe Co.,	300 H.P.
Oliver Iron & Steel Co.,	350 "
Standard Underground Cable Co.,	450 "
Reeves Iron Co.,	500 "
National Galvanizing Works,	600 "
Firth-Sterling Steel Co.,	850 "
Sharon Iron Co.,	1,000 "
National Tube Works,	1,500 "
Oliver-Snyder Steel Co.,	3,000 "
Ohio Steel Co ,	4,000 "
Monongahela Furnace,	5,300 "
Shoenberger Steel Co.,	5,500 "
Oliver Wire Co.,	6,000 "

ACORNS—IN ABOUT TWO YEARS—OAKS.

ATTENTION TO LITTLE DETAILS.

Starting with a thoroughly good design we have improved the COCHRANE FEED WATER HEATERS point by point, by giving careful consideration to each detail of construction, so that these appliances will be complete—practically automatic—very reliable—and particularly easy to clean.

It is so easy to claim "cure all" properties, and to "crack up" an article that many people are inclined to class our advertising statements with some others they have met, and yet our best salesmen are those who are using our goods. Take one section—Pittsburg and vicinity, two years ago we were hardly known out there, a concern risked our statements, and put in a "COCHRANE." From which little beginning sprang the list presented herewith of just one industry.

HARRISON SAFETY BOILER WORKS, Mfrs. PHILADELPHIA, PA.

Pittsburg, Pa., F. R. DRAVO & CO., Lewis Blk. Cleveland, O., R. M. FULLER, (434 Arcade.)

This race-way is cast iron, the grooves smoothed and polished.

Attention is next called to the design of sand-sifter presented in Fig. 4, in which the feature of note is the method of introducing the sand in a cylindrical cradle. The cradle is a wire covered cylinder, provided with the ribs C C, and set in end bearings A A, as shown. The bearings are of the ball system, and the arrangement of the balls and cones is shown at B, the box being shown in cut-off.

The reason that I use ball-bearings in sand-sifting machinery is because power is saved owing to reduced friction, and the motion resulting is peculiarly adaptable to a machine of the nature of a sand-sifter. The mode of introducing the sand into the cylinder is through the tin or sheet iron D, the sand falling from above and reaching the union where it is to enter the cylinder pipe E, a blast of air from a blow-pipe F sends it forward into the machine, where it is sifted, falling out through the wire at the bottom into receptacles. An ordinary blower serves to furnish the air to the blow-pipe, in which pipe should be a check valve. The pipe E is provided with sleeves at the bearing, so that it serves to substitute a shaft for that end of the cylinder.

The forms of sifters from Figs. 5 to 7 are given because they are odd in design. The writer tried them all, making the cradles in each case with wooden ends, and covering the rib work with the regulation sand-sifting wire. The bearings are flanged pipes, as marked A, B and C. Fig. 5 is a perfectly square pattern; B is three-sided and seven oblong. These are turned in bearings set up on the plan adopted in Fig. 4. In Fig. 8 is a somewhat complicated yet efficient sifter for getting three grades of sand—fine, medium and coarse. The view shows the cylinders in section. The sand is admitted to the central cylinder A from the feed pipe, which cylinder is covered with coarse wire, permitting the required grade of sand to pass through to the second cylinder B, which is covered with medium wire, from whence the next grade of sand passes to the final cylinder C, the latter being covered with fine wire. The three cylinders being on a slant, the rejects are passed out at the lower ends on to the planes D, E and F and into the respective wooden shutes G, H and I. The body of the cylinder is revolved upon the wooden friction wheels K K.—[Geo. D. Rice, in Machinery.

THE ninth annual convention of the American Boiler Manufacturers' Association will be held in Philadelphia on July 27, 28 and 29. The programme includes the following paper: "The Acushnet Boiler Explosion," by H. S. Robinson; "Modern Marine Boilers," by H. S. Hartley, Philadelphia; "Uniform American Boiler Specifications," by E. D. Meier, St. Louis. The committee on materials will make a report and there will be a general discussion of ten topical questions.

THE mineral production in May for the State of Alabama as reported to Dr. Eugene A. Smith, State Geologist and Secretary of the Alabama Industrial and Scientific Society, is as follows: Coal, 311,197 tons; coke, 84,630 tons; iron ore, 147,575 tons; limestone and dolomite for flux, 33,554 tons; pig iron, 64,429 tons; lime, 3,952 barrels; building stone, 3,500 cubic feet. Number of employes in above industry, 13,169.

INDUSTRIAL SUMMARY.

New Buyers in the Market, and Some of Their Wants:—

[If you are in need of machinery of any description, please notify *The Iron Trade Review*, and we will put you in communication with our advertisers at once.]

At Columbus, O., incorporation papers have been issued to the Niles Boiler Co., Niles, O.; capital, $25,000.

At Depew, N. Y., a notice was posted at the works of the Gould Coupler Co. last week notifying the molders and core makers that, beginning July 12 they would receive five cents less for each piece than heretofore. This means a reduction of 50 cents a day to the molders and 37 cents to the coremakers. The reduction will be accepted, with the assurance that wages will be restored just as soon as business conditions warrant.

George T. Robinson, William H. Rea, Henry R. Rea, William C. Robinson, and Henry H. Robinson, of Pittsburg, will make application on the 13th inst. for the chartering of a new company to be known as the Keystone Crusher & Roller Co.

The Tar River Oil Co., Tarboro, N. C., asks bids on three round iron tanks nine feet diameter and seven feet high.

A. J. Beckley & Co., Garwood, N. J., are in the market for a six-foot planer and a punching machine.

Messrs. H. C. Strong, R. E. Schuck, Jas. Flynn and Frank M. Underwood have formed the Underwood Motor Co., at Sandusky, O., with a capital of $10,000, to manufacture stationary, portable, and marine engines.

Wm. E. Jones, of Pittsburg, J. R. Rose, of Zelienople, and F. Protzman, Sr., of Allegheny, are reported to be planning the erection of a steel plant at Waynesburg, Pa., with 100 tons daily capacity.

New Construction:—

The foundry works of the George Sweet Mfg. Co., at Dansville, N. Y., which were recently destroyed by fire, are to be rebuilt, and new and improved machinery will be installed.

The new shops of the Merchants' Despatch Transportation Co., at Penfield, N. Y., the new manufacturing city near Rochester, will probably be finished Sept. 1.

It is stated that E. E. Southern, of the E. E. Southern Iron Co., St. Louis, Mo., will erect an iron foundry at San Luis Potosi or Aguas Calientes, Mexico, to cost between $75,000 and $100,000, to supply the Mexican trade better than can be done from the works at St. Louis.

The Penn Bridge Co., of Beaver Falls, has been awarded the contract for the State bridge over the Susquehanna River at Catawissa, Pa., at its bid of $81,400.

The Fessenden Mfg. Co., of Pittsburg, has taken out a building permit for a new building to be erected in Pittsburg. The company manufactures electrical goods, arc lights and X-ray machines of the Fessenden pattern.

Additions, Enlargements, Removals, Etc.:—

The Grand Crossing (Ill.) Tack Co. will build a three-story addition.

The Pittsburg Wire Co. has begun the erection of the new

MOUNT SAVAGE FIRE BRICK.

UNION MINING CO.,

Proprietors of the CELEBRATED Mount Savage Fire Brick

GOVERNMENT ⁑ STANDARD.

Established 1841. Capacity, 60,000 Per Day; 18,000,000 Per Year.

The First Manufactory of its Kind in the U. S.

Home Office and Works:—MOUNT SAVAGE, Alleganv County, Md.

Branch Offices:—No. 1 Broadway, New York, N. Y.; No. 222 So. Third St., Philadelphia, Pa.; Ferguson Block, Pittsburgh, Pa., Stowe, Fuller & Co., 195 Merwin St., Cleveland, Ohio.

nail mill planned some months ago. The foundations are laid but conditions have not been such as to justify pushing the work until now.

The Struthers (O.) Iron & Steel Co., which has operated the old Summers Bros. plant for two years is laying the foundations of a galvanizing plant 50 x 150 feet, which will be in operation in September. In the past two years the company has added a new sheet mill, two scrap furnaces and a set of cold rolls.

The Kearney & Foot Co., file manufacturers of Paterson, N. J., have purchased property at Kent, Ohio, and removed their plant to that place.

The Struthers Iron & Steel Co., Struthers, O., manufacturer of sheet iron and sheet steel, is adding to its works a complete galvanizing shop and putting up a new building, 150 x 50 feet in size. This concern will have galvanized sheets ready for the trade by September 1 next. It is also making other extensive repairs and improvements to the plant which will greatly increase the output and steam facilities.

The Warren City Boiler Works, Warren, Ohio, is building a new shop 100 feet wide and 200 feet long, fitted with a traveling crane of 45 foot span. The concern is adding to its equipment new punches, shears, hammers and rolls, and expects to have one of the best equipped boiler plants in the Mahoning Valley. It is now building a system of 20 large tanks at Buffalo, N. Y., for a new grain plant, the tanks to have a capacity of 1,000,000 bushels. It is also building a lot of large condensers and oil tanks for the Independent Refining Co., of Oil City, Pa., and a stand pipe 14 feet in diameter and 110 feet high, at Gibsonburg, O., besides having considerable other work now in hand.

General Industrial Notes:—

The horizontal duplex cross compound condensing Bessemer blowing engine recently sold by the Edward P. Allis Co. to the Duquesne Steel Works, has 76-inch air cylinders and 60-inch stroke. The steam cylinders are of the Reynolds-Corliss type with high pressure cylinder 46 inches diameter, and a low pressure cylinder 88 inches diameter, each 60-inch stroke. This engine will deliver 28,000 cubic feet of free air at a pressure of 30 pounds per square inch.

The Enterprise Boiler Co., Youngstown, O., has entered on the manufacture of galvanizing kettles.

A notice was posted at the south mill of the Lackawanna Iron & Steel Co., July 11, that the mill would open for work this week. Two weeks ago the men refused to work because the tonnage scale had been cut 15 to 40 per cent. The notice posted says the old hands who decline to begin work will be dismissed from the company's service. The pay is to be according to the revised tonnage scale. It will average 25 to 30 per cent below the old scale.

The J. H. Sternberg Works at Reading, Pa., are completing a large order for bolts and nuts for shipment to Japan for use on railroad work.

Among recent car orders are 200 for the Philadelphia & Reading building at its own shops; 150 now being figured on for the International & Great Northern; 400 box and 100 gondola cars which the Ohio Falls Car Mfg. Co. is rebuilding for the B. & O. Southwestern; 600 box cars building at the Perth shops of the Canadian Pacific, in addition to two contracts of 200 cars each to Canadian works for the same road; 300 cane cars now building at the Chattanooga Car & Foundry Co.'s works.

The W. Dewees Wood Co.'s mill Nos. 6, 7, 8 and 9, at McKeesport, resumed this week after several weeks of idleness. Other departments will also resume this week.

The National Tube Works Co., McKeesport, Pa., has leased the coal mines of O'Neil & Peterson, at Brunola, Pa., and will start them at once.

The Homestead works of the Carnegie Steel Co. are now on their fifth week of continuous operation in full.

The Buhl open-hearth steel plant at Sharon, Pa., goes on in full this week.

The rolling mills of the National Tube Works at McKeesport, Pa., resumed July 12. The puddlers are still on a strike for the $4.50 rate.

Sarah Furnace at Ironton, O., has blown out and Hamilton Furnace is the only one in Lawrence County now running.

The new foundry of the Virginia Iron Works, Virginia, Minn., has made its first heat and has run off a lot of special castings successfully.

When Struthers Furnace, Struthers, O., starts again it will be with enlarged bosh, work on which is now in progress.

The recent shipment of iron to Glasgow by the Sloss Iron & Steel Co. was 2,000 tons, not 10,000 tons, as reported in several papers.

All departments of the mill of the Fox Pressed Steel Co., Pittsburg, have been started on double turn. The mill was to

U. BAIRD MACHINERY CO.

123 AND 125 WATER STREET, **PITTSBURG, PA.** 124 AND 126 FIRST AVENUE.

MACHINE TOOLS AND SUPPLIES.

Some SECOND-HAND TOOLS in stock.

1—8-ft. Boring Mill.
1—No. "D" Horizontal Boring & Drilling Machine.
1—Garvin Profiler.
1—A. T. & M. Co. Valve Milling Machine.
4—No. 11 Brown & Sharpe Milling Machines.
2—No. 1½ Stiles Presses.
1—No. 3 Stiles Press.
1—36-in. G. & E. Spur Gear Cutter.
2— Crank Planers.
3—No. 1 Brown & Sharpe Screw Machines.
2—No. 6 Brown & Sharpe Screw Machines.
1—36-in. Car-wheel Borer.
1—55-in. Pneumatic Riveter.
1—30-in. Pulley Lathe.
1—Pratt & Whitney Turret Lathe.
1—109 in. Engine Lathe.
1—15-in. Fox Turret Lathe.
1—20-in. Lodge-Davis Turret Lathe.
1—20-in. x 10-ft. Gleason Engine Lathe.
1—24-in. x 12-ft. Gleason Engine Lathe.
1—3-Spindle Drill Press.
2—30-in. Drill Presses.

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Steel Plants, Sheet and Tin Plants, Gas Furnaces and Producers Structural Iron and Steel.

Automatic Billet Heating Furnaces. **Plans and estimates furnished.**

CONESTOGA BLDG., PITTSBURG, PA.

"THE IRON TRADE REVIEW"

is an increasingly valuable medium throug which to sell equipment to machine shops and foundries.

have started months ago, but an injunction was taken out against the company. A combination has been effected and nothing but steel car trucks will be manufactured.

At Baltimore, the U. S. Circuit Court authorized the receivers of the B. & O. road to issue $680,000 worth of certificates to pay for 40,000 tons of rails at $17. The application was opposed by J. P. Morgan & Co. and others, but the court held that the earning power of the property would be increased. The receivers had options on 50,000 tons of rails at $17. The order will be given the Carnegie Steel Co.

The Lake Erie Iron Co., Cleveland, some of whose coal has been confiscated by railroad, while en route, will test the right of the roads to appropriate it.

The Keystone Drop Forge Co., Philadelphia, has purchased the entire plant and appurtenances of what was formerly known as the Philadelphia Drop Forge Co. A. Morris Hall is manager.

At the Haselton mill of the Andrews Bros. Co. and at the plant of the Mahoning Valley Iron Co., Youngstown, O., repairs and improvements are being made, giving the plants greater efficiency when started up again. Stock is being unloaded at the Haselton blast furnace ready for resumption.

Among recent signatures of the Amalgamated Association scale are those of the Blairsville (Pa.) Rolling Mill & Tin Plate Co., the Washington (Pa.) Steel & Tin Plate Co., the La Belle Iron Co., Wheeling; American Tin Plate Co., Elwood, Ind.; the Humbert Tin Plate Co., Connellsville, Pa.; the Britton Rolling Mill Co., Cleveland; Licking Rolling Mill Co., and Mitchell, Tranter & Co., Covington, Ky.

The Cleveland Machine Screw Co.'s plant will not be sold to an English or a French syndicate, as reported, unless a new deal is made. An offer was made some time ago but negotiations did not come to anything. The consideration talked of is reported at upwards of $900,000.

The Newton Machine Tool Works, of Philadelphia, has been incorporated with a capital of stock of $225,000. The officers are: President and treasurer, Chas. C. Newton; secretary, H. W. Champion; assistant treasurer, W. M. Graham; assistant secretary, E. J. Hannum.

Punxutawney (Pa.) Furnace, in which Rogers, Brown & Co. are largely interested, will start up this month, having booked orders for the first six weeks' production.

No. 1 blast furnace of the Bellaire (O.) Nail Works was started last week after several months' idleness.

Receiver McGettigan, of the Premier Steel Co., Indianapolis, Ind., has filed a report with the circuit court stating that from August 1, 1896, until June 28, 1897, the receipts were $21,929 66, and disbursements $12,485.43, leaving a balance on hand of $15,041.48. He says that the American Steel Co. left the property in better condition than it found it.

The Allentown Rolling Mills, of Allentown, Pa., have agreed to lease the Lehigh mill of that plant temporarily, to test a new process for the conversion of iron and steel scrap into material for manufacturing products. The lessee is the Biddell Purchasing Co., of Philadelphia, and the invention of Wm. C. Nelson, of Harrisburg, is to be tested. The mill will soon be ready to start.

Owing to a defect in the steel casing of the furnace stack, Hinkle Furnace of the Ashland Iron & Steel Co., Ashland, Wis., has been blown out. Blast No. 5 has consisted of 1,026 days, during which the furnace was stopped 76 days, making a run of 950 days, in which 110,210 tons of iron were made, a daily average of 116 tons.

The Frick Co., of Waynesboro, Pa., is figuring with the Chautauqua Lake Ice Co., of Pittsburg, for the building of a large lot of ice machinery.

The plant of the South Sharon Steel Co., at South Sharon, Pa., will commence operations soon. The concern will roll girder rails of all sizes and shapes. The Holland Co., Hamilton Building, Pittsburg, Pa., is selling agent.

The Bellaire Steel Co., Bellaire, O., manufacturer of Bessemer steel in its various forms, has notified the tonnage men of a reduction in wages ranging from 15 to 20 per cent. The plant of this concern is idle at present to allow repairs and extensive additions to be made to equipment.

Proceedings have been started to foreclose the mortgages of the Wellman Steel Co., Chester, Pa., with the intention of having a sale in the fall. The bonded debt of the Wellman Steel Co. is $100,000 first $200,000 second mortgage bonds, both drawing interest at six per cent, and $300,000 five per cent bonds. The foreclosure is being made on the first mortgage bonds, the interest of which has been in default since July 1. If the plant comes to a sale, it is believed that S. A. Crozier, in the absence of strong bidders, will take the property to protect his interest. The estimated value of the real estate is $120,000, and there is scrap about the plant worth about $150,000. The plant was sold at sheriff's sale some years ago, and was bought by a syndicate, but has not been operated since. Some time ago the Russian Government bought machinery to the amount of $50,000.

An assignee has been appointed for the Morgan Boiler Co., Akron, O. The company has manufactured the Morgan patent boiler for steam heating. Losses resulting from the conduct of the Chicago agency are the principal cause of the embarrassment. These were made two or three years ago, but the stockholders were assessed and have hitherto saved the business from being seriously crippled.

The plant of the Westinghouse Air Brake Co., at Wilmerding, Pa., which heretofore has been operated only four days per week of eight hours each, is now running five days of eight hours each.

The employes of the Baker Chain & Wagon Iron Mfg. Co.,

Allegheny, Pa., will hereafter work nine hours per day, instead of eight, with a corresponding increase in wages.

SEASHORE EXCURSION.

Via Pennsylvania Lines This Summer.

General excursions to the seashore at exceptional low rates will be inaugurated by the Pennsylvania Lines this summer, offering grand opportunity for delightful outings at the most popular ocean resorts on the continent. This announcement will be good news to persons who may desire to enjoy their vacation at the seaside. They may visit Atlantic City, Cape May, Avalon, Sea Isle City, Anglesea, Ocean City, Holly Beach or Wildwood at very low fare, round trip tickets to either resort being obtainable at the same rate.

The first excursion will be run Thursday, July 15th, followed by a second four weeks later, Thursday, August 12th. Round trip rates to either Atlantic City, Cape May, Avalon, Sea Isle City, Anglesea, Ocean City, Wildwood or Holly Beach, New Jersey, will be $12.50 from Ft. Wayne and Toledo; $12 from Lima, Crestline, Tiffin, Mansfield; $11.50 from Orrville, Cleveland, Canton, Massillon, Youngstown, Girard, Niles; and $11 from Alliance.

The return limit will cover 12 days, including date of sale, which will be ample for customary ten days' vacation. For further desired information, address C. L. Kimball, Assistant General Passenger Agent, Cleveland, O., for particulars. Illustrated description of resorts to which excursion tickets will be sold, with list of hotels and boarding houses at each, will be furnished upon application.

LOW RATES.

Via Pennsylvania Lines.

Special reductions in fare over the Pennsylvania Lines will be granted for numerous events to take place this summer in various parts of the United States, in addition to local excursions. Some of the points to which tickets will be sold and dates of sale are as follows:

To Nashville, Tenn., daily to October 15th, for Tennessee Centennial and International Exposition.

To Winona Assembly Grounds, Eagle Lake (near Warsaw, Ind.), May 15th to August 31st, for Annual Assembly and Summer School.

To Cincinnati, July 21st and 22d, for German Epworth League Meeting.

To Indianapolis, August 17th and 18th, for Y. P. C. U. Annual Convention.

To Indianapolis, September 8th and 9th, for National Encampment Sons of Veterans.

The reduced rates over the Pennsylvania Lines will not be restricted to members of the organization mentioned, but may be taken advantage of by the public generally. Excursion tickets may be obtained at ticket offices on the Pennsylvania System and will be sold over this route by connecting railways. Any Pennsylvania Line Ticket or Passenger Agent will furnish desired information concerning rates, time of trains, return limit, and other details to all applicants, or the same may be obtained by addressing C. L. Kimball, Assistant General Passenger Agent, Clevealnd, O.

ALLEN'S anti-rust paint is used to prolong the life of old tin, iron or steel roofs. It costs little and lasts long. The Allen Anti-Rust Mfg. Co., 413 Vine St., Cincinnati.

$8 From Cleveland to Mackinac and Return.
$7 From Toledo to Mackinac and Return.
$6 From Detroit to Mackinac and Return.

The above special tourist rates were put into effect June 20, via Detroit & Cleveland Steam Navigation Co.'s new mammoth steel passenger steamers. The round trip from Cleveland, including meals and berths, costs $16, from Toledo $14, from Detroit $11.50. Send 2 cents for illustrated pamphlet. Address A. A. Schantz, general passenger agent, Detroit, Mich.

A Lake Tour to the Island of Cool Breezes.

Go to Mackinac Island, Mich., via the Coast Line. The D. & C. new steel passenger steamers leave Toledo, Mondays and Saturdays, 10.30 A. M., and Tuesdays and Thursdays, 4.30 P. M. From Detroit, Mondays and Saturdays, 11.00 P. M., Wednesdays and Fridays, 9.30 A. M. Send two cents for illustrated pamphlet. Address A. A. Schantz, general passenger agent, Detroit, Mich.

Steam Yachts and Marine Machinery.

Also Towing Launches built by Marine Iron Works, Clybourn and Southport avenues, Chicago. Free illustrated catalogue. Write them for it.—*Adv.*

"Metallurgy of Cast Iron,"

By THOS. D. WEST; 107 engravings, 583 pages. Just issued. A valuable work to Founder, Molder, Draughtsman, Designer, Technical School Specialist. Chemistry of Iron; cheaping of mixtures; the effect of the metalloids in changing the grade of iron; latest improvements in cupola construction and practice—all are fully covered. Price $3. Sent postpaid on receipt of price, by *The Iron Trade Review Co.*, Cleveland, O; 1142 Monadnock Block, Chicago, Ill.

James M. Swank, author of "Iron in All Ages," and editor of the *Bulletin* of The American Iron & Steel Association, in reviewing "Metallurgy of Cast Iron," says it is "One of the most valuable publications relating to the manufacture of iron castings, that has ever, to our knowledge, been issued in this or any other country."

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If an old leaky tin, iron or steel roof, paint it with Allen's Anti-Rust Japan. One coat is enough; no skill required; costs little; lasts long.

The name describes it; proof against water, time, climate, and fumes of every description. Stops leaks, and prolongs the life of an old roof.

If you want evidence write us. To be returned at our expense if not satisfactory.

This Anti-Rust is also of highest value in protecting metal pipes, fans, etc., at mines, exposed to the corroding effects of *mine air* and *mine water*.

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The name of the Chicago, Milwaukee & St. Paul Railway has long been indentified with practical measures for the general upbuilding of its territory and the promotion of its commerce, hence manufacturers have an assurance that they will find themselves at home on the company's lines.

The Chicago, Milwaukee & St. Paul Railway Company owns and operates 6,154 miles (9,900 kilometers) of railway, exclusive of second track, connecting track or sidings. The eight States traversed by the lines of the company, Illinois, Wisconsin, Northern Michigan, Iowa, Missouri, Minnesota, South Dakota, and North Dakota, possess, in addition to the advantages of raw material and proximity to markets, that which is the prime factor in the industrial success of a territory—a people who form one live and thriving community of business men, in whose midst it is safe and profitable to settle. Many towns on the line are prepared to treat very favorably with manufacturers who would locate in their vicinity.

Mines of coal, iron, copper, lead and zinc, forests of soft and hard wood, quarries, clays of all kinds, tan-bark, flax and other raw materials exist in its territory in addition to the vast agricultural resources.

A number of new factories have been induced to locate—largely through the instrumentality of this company—at towns on its lines. The central position of the States traversed by the Chicago, Milwaukee & St. Paul Railway, makes it possible to command all the markets of the United States. The trend of manufacturing is Westward. Nothing should delay enterprising manufacturers from investigating. Confidential inquiries are treated as such. The information furnished a particular industry is reliable.

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Industrial Commissioner, C., M. & St. P. R'y
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STEAM TUBE WELDING WORKS.

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Good second-hand tubes bought.

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$2.50 CLEVELAND TO BUFFALO.

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Steamers "City of Buffalo," (new) "State of Ohio" and "State of New York."

DAILY TIME TABLE.
Sunday included May, 30 to October 3.

Lv. Cleveland,	7:00 P. M.	Lv. Buffalo,	7:30 P. M.
Ar. Buffalo,	7:30 A. M.	Ar. Cleveland,	7:30 A. M.

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Take the "C. & B. Line" steamers and enjoy a refreshing night's rest when enroute to **Buffalo, Niagara Falls, Toronto, New York, Boston, Albany, 1,000 Islands,** or any Eastern or Canadian Point. **Cheap Excursions Weekly to Niagara Falls.**

Send 4 cents postage for tourist pamphlet.
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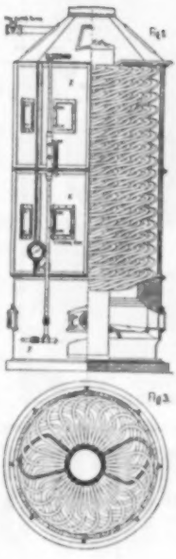
THE CLONBROCK STEAM BOILER CO.,
BROOKLYN, N. Y.



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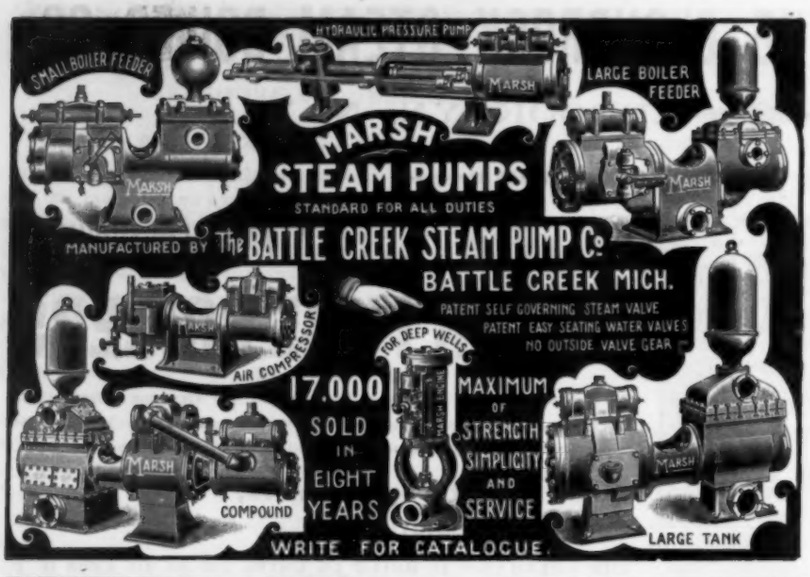

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OF THE

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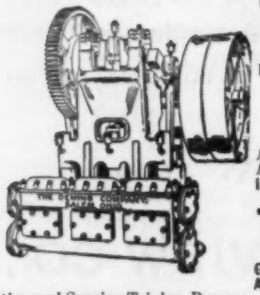
Is a thorough revision of the list of blast furnaces, rolling mills, Bessemer and Open-Hearth steel works, plate and sheet mills, nail mills, tin plate mills, malleable, cast iron pipe and wrought pipe works, car wheel and locomotive works.



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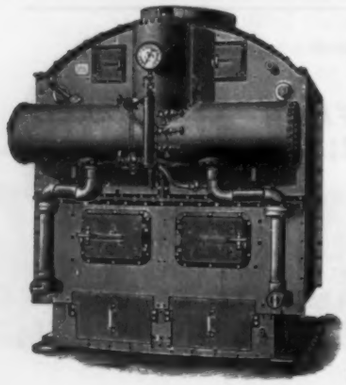

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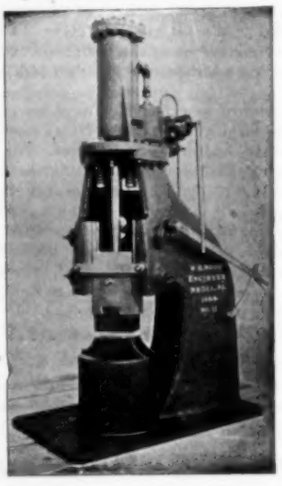

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FROM CLEVELAND TO	LEAVE	ARRIVE
Pittsburgh and Bellaire	† 7:00 am	†12:10 pm
Salem and Pittsburg	* 8:00 am	* 8:30 pm
Pittsburgh, Bellaire and East	† 3:15 pm	† 6:25 pm
Philadelphia and New York	* 1:40 pm	*11:25 am
Baltimore and Washington	* 1:40 pm	*11:25 am
Alliance and Pittsburgh	* 1:40 pm	*11:25 am
Ravenna and Alliance	* 5:00 pm	* 8:40 am
Philadelphia and New York	*11:10 pm	* 4:30 am
Baltimore and Washington	*11:10 pm	* 4:30 am
Alliance and Pittsburgh	*11:10 pm	* 4:30 am

Mt. Vernon and Pan-Handle Route

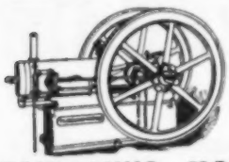
FROM CLEVELAND TO	LEAVE	ARRIVE
Xenia and Cincinnati	* 8:50 am	* 5:30 pm
Akron and Columbus	* 8:50 am	* 5:30 pm
Akron and Columbus	† 1:40 pm	†12:10 pm
Columbus and Cincinnati	* 8:00 pm	* 7:30 am

The Cleveland Terminal & Valley R. R. Co.

(B. & O. System.)

Depot foot of So. Water St. City Office 241 Superior St.	Arrive.	Depart.
Valley Jctn. & Way Stations	*6:20 P M	*7:10 A M
Akron, Canton & Valley Jct	*10:00 A M	*3:30 P M
Akron, Canton & Chicago	*8:10 A M	*6:35 P M
Akron, Canton & Wooster, Defiance, Garrett, Marietta, Wheeling, Washington, D. C., and Baltimore	†2:25 P M	†11:00 A M

†Daily except Sunday. *Daily. Pullman's Palace Vestibule sleeping cars between Cleveland and Chicago.



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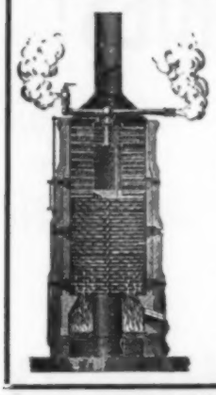
The Great Coal Saver and Producer of Dry Steam.



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16 Years' Unequalled Record for Economy, Safety and Durability.

No Explosions or Accidents of Any Kind.

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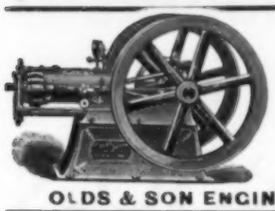

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BECAUSE { No gears or levers, simplest carburetor, onderful Economy,

KNOW the REQUIREMENTS of a Gas Engine.

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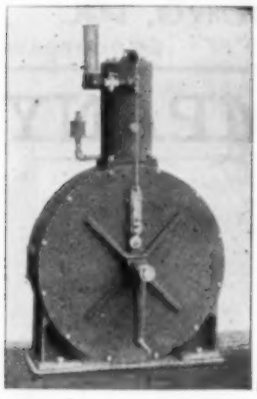

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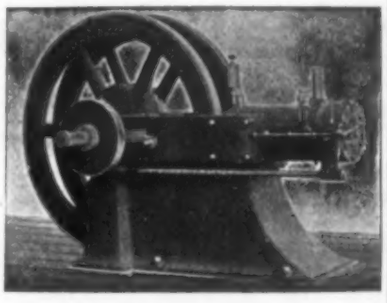

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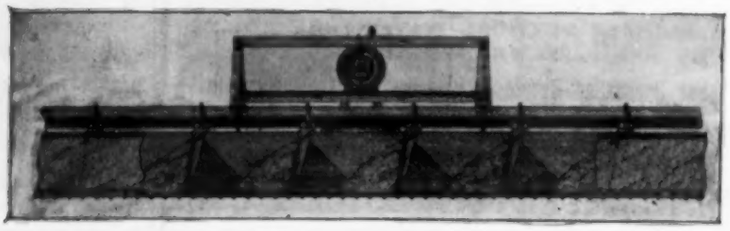

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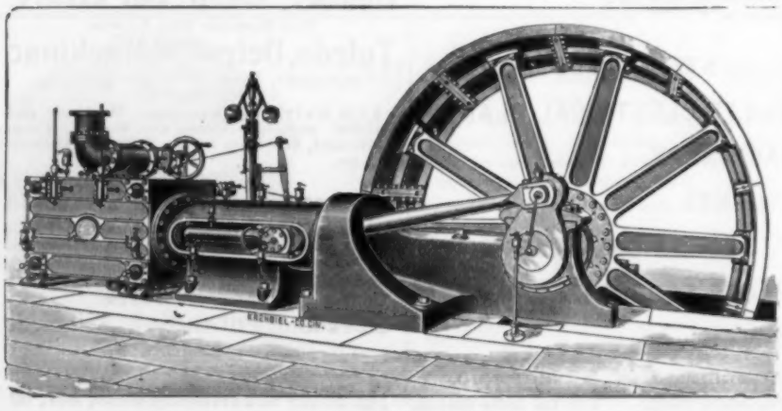

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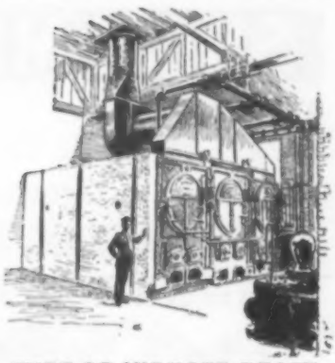

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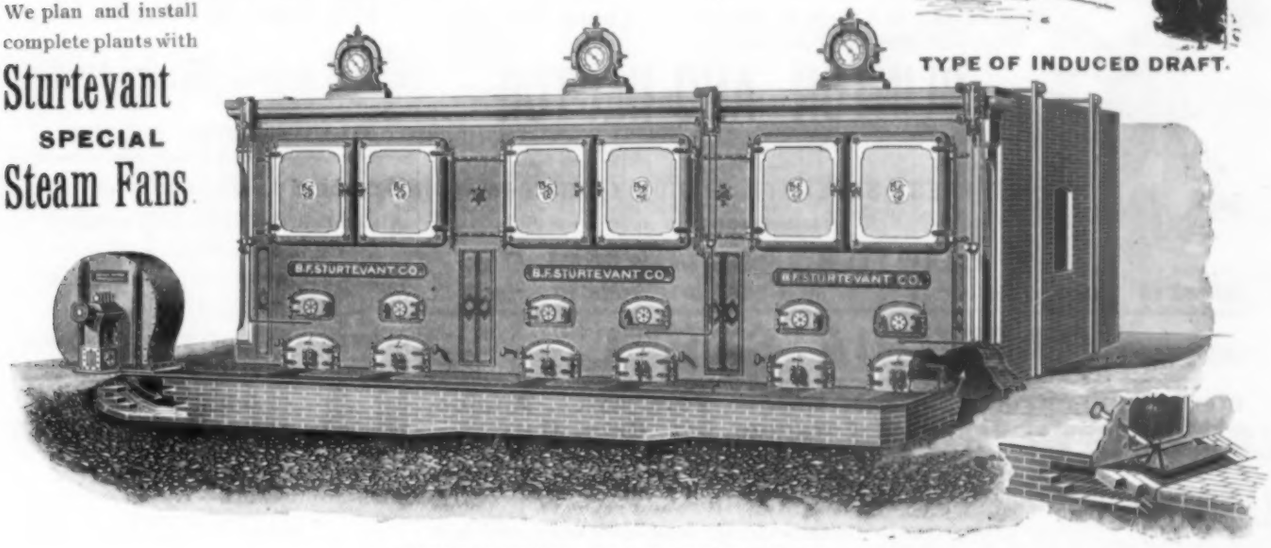

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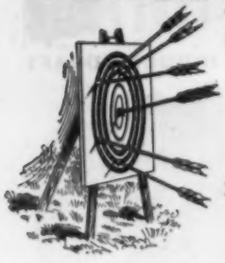

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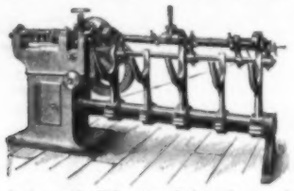

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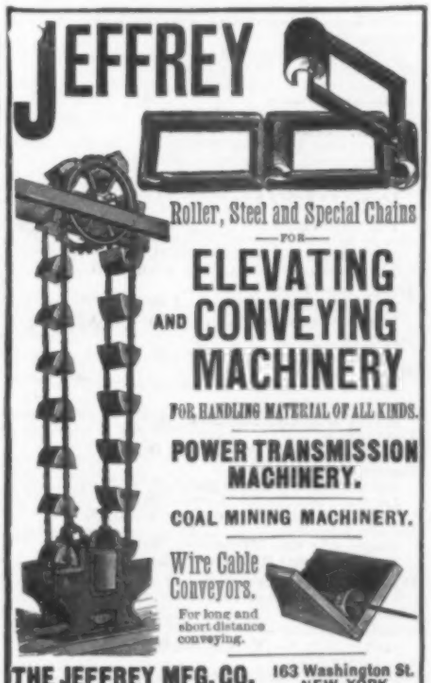

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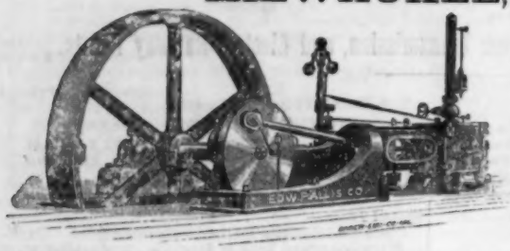

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Bessemer	$ 9 65@ 9 75
No. 1 Strong Foundry	10 25@10 65
No. 2 Strong Foundry	9 65@10 15
No. 1 Gray Forge, red short	8 65
No. 2 Gray Forge, neutral	8 75
No. 1 American Scotch	10 65
No. 2 American Scotch	10 15
Lake Superior Charcoal	12 75@13 00
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No. 1 Foundry	$10 25@10 50
No. 2 Foundry	9 50@ 9 75
Gray Forge	8 40@ 8 50
White and Mottled	8 50
Warm Blast Charcoal	14 50@15 00
Cold Blast Charcoal	17 00
Bessemer	9.00@ 9 10
CHICAGO:	
Lake Superior Charcoal	$13 00@$13 20
Local Coke Foundry No. 1	10 25@10 75
Local Coke Foundry No. 2	10 25@10 50
Local Coke Foundry No. 3	10 00@10 25
Local Scotch Foundry No. 1	10 50@10 75
Local Scotch Foundry No. 2	10 25@10 50
Local Scotch Foundry No. 3	10 00@10 25
Southern Coke No. 1	10 50@11 00
Southern Coke No. 2	10 00@10 25
Southern Coke No. 3	9 75@10 00
Southern No. 1 Soft	10 50@11 00
Southern No. 2 Soft	10 00@10 50
Southern Silveries	10 25@10 50
Jackson Co. Silveries	13 00@15 00
Ohio Silveries No. 1	13 00@15 00
Ohio Strong Softeners	12 00@12 25
Alabama Car Wheel	16 50@16 00
Malleable Bessemer	10 75@11 00
Coke Bessemer	11 50@12 00
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Southern Coke No. 1, Foundry	$ $ 9 75
Southern Coke No. 2 and No. 1 Soft	9 00
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Hanging Rock Charcoal No. 1, Fdy	14 50@15 50
Tennessee Charcoal No 1	12 50@13 00
Jackson County Silvery No 1	12 50@13 00
Southern Coke, Gray Forge	8 00@ 8 25
" " Mottled	8 00
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Tennessee " "	13 00@14 00
Lake Superior " "	14 75@15 25
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Jackson Co. Silvery No. 1	14 00
Lake Superior Charcoal	14 00
Southern Soft No. 1	10 50@10 75
Hanging Rock Charcoal	17 00
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Southern Coke No 1	$ 9 50@$ 9 75
Southern Coke No. 2	9 00@ 9 25
Southern Coke No. 3	8 50@ 8 75
Southern Gray Forge	8 00@ 8 25
Southern Charcoal No. 1	13 00
Missouri Bessemer	12 00
Ohio Softeners	13 50
Lake Superior Car Wheel	14 50
Southern Car Wheel	14 50

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Wrought turnings (free from cast)	5 50
Cast borings	4 55
Uncut wrought iron boilers	3 78
Steel boiler plates	7 00
Grate bars	5 00
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Tank iron	7 00
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Sheet iron	5 00
Wrought drillings	5 00
Malleable iron	8 50

STRUCTURAL MATERIAL.

Beams and Channels (f. o. b. Cleveland)	1.10c
Angles	1.10c
Tees	1.20c
Universal Plates	1.10@1.15c
Sheared Plates	1.15c

MERCHANT IRON AND STEEL.

[Less than car-lots, Cleveland.]

Rounds and Squares.—Bar Iron.

1 to 1⅞	1.00 Base
2 to 2⅞	.20 extra
3 to 3½	.50 "
3⅝ to 4	.80 "
4⅛ to 4½	1.00 "
4⅝ to 5	1.30 "
5⅛ to 6	1.80 "
6¼ to 6⅜	2.30 "

PERFORATED METALS

OF ALL KINDS FOR

MILLING, MINING AND AGRICULTURAL MACHINERY.

Perforated Iron, Steel, Copper, Brass, Tin, Zinc, Lead, Etc., to Order.
Large and Varied Assortment of Sizes. Correspondence Solicited.

THE ROBERT AITCHISON PERFORATED METAL CO.,

Office, Room 510, 265 to 269 Dearborn St., CHICAGO, ILL. Works, So. Chicago.

Dixon's Pure Flake Graphite

Is a Blessing to Every Engine Room and Machine Shop.

A small quantity added to any Oil or Grease largely increases its lubricating value and makes the finest Cooling Mixture.

Pamphlet and Sample Sent Free.

JOS. DIXON CRUCIBLE CO., Jersey City, N. J.

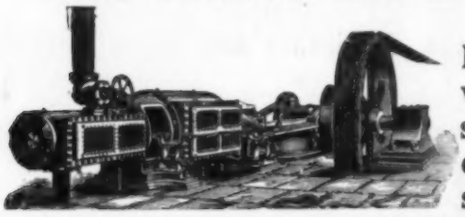
Don't Waste Money in Your Pattern Shop.

THE GOBEILLE PATTERN CO., Cleveland.

WILLIAM TOD & CO.

YOUNGSTOWN, OHIO.

The Porter-Hamilton Engine



Reversing Engines, Blowing Engines, Converters, Hydraulic and special heavy machinery for the iron and steel trades.

Williams Improved Vertical Engines

For Direct Electrical and all High Class Work.

39-41 Cortland St., N. Y. E. F. WILLIAMS.

Park Building, Pittsburg, SEWARD S. BABBITT.

Persistence in Advertising

Is one of the requisites of satisfactory results. In the expansion of business which is confidently expected in the United States in the very near future, advertisers who have made themselves regularly prominent in the past two years will be first to reap the rewards of persistent publicity.

IRON CLAD PAINT CO.

Factory, 75 & 77 Central Way. Sec. & Treas., No. 3 Case Build'g.

CLEVELAND OHIO.

Trade Mark Patented.

ORDER DIRECT FROM THE

Iron Clad Paint Co.

And get the genuine article, and save liability of suit for using an article made in violation of the patents issued to Wm. Green, and now owned by this Company.

IRON CLAD PAINT is the most durable, most fire-proof and Cheapest Paint made.

FURNISHED both Dry and Ground in Oil

USED BY NEARLY ALL THE RAILROADS.

6⅝ to 7¼	2.50 extra.
¼ to ⅞	.10 "
⅝ to 11-16	.20 "
½ to 9-16	.30 "
7-16 to 15-32	.40 "
⅜ to 13-32	.50 "
5-16 to 11-32	.70 "
¼ to 9-32	.90 "
7-32	1.40 "
3-16	2.50 "

Flats.—Bar Iron.

1¼ to 4 x ⅜ to 1	1.05 Base.
4¼ to 6 x ⅜ to 1	.10 extra.
6¼ to 8 x ⅜ to 1	.60 "
8¼ to 10 x ⅜ to 1	.80 "
1⅜ to 4 x 1 1-16 to 1½	.30 "
4¼ to 6 x 1 1-16 to 1½	.40 "
6¼ to 8 x 1 1-16 to 1½	.60 "
8¼ to 10 x 1 1-16 to 1½	.90 "
2 to 4 x 1⅝ to 2	.50 "
4¼ to 6 x 1⅝ to 2	.60 "
6¼ to 8 x 1⅝ to 2	.80 "
8¼ to 10 x 1⅝ to 2	1.00 "
2 to 4 x 2⅛ to 3	.60 "
4¼ to 6 x 2⅛ to 3	.80 "
6¼ to 8 x 2⅛ to 3	1.00 "
1⅜ to 1¾ x ⅜ to 1	.10 "
1 to 1 1-16 x ⅜ to ⅞	.20 "
¼ to 15-16 x ⅜ to ⅞	.40 "
⅝ to 11-16 x ⅜ to ⅞	.50 "
½ to 9-16 x ⅜ to ⅞	.90 "

Heavy Band Iron.

7 to 10 x ¼ to 5-16	.70 extra.
6¼ to 6¾ x ¼ to 5-16	.50 "
4¼ to 6 x ¼ to 5-16	.30 "
1½ to 4 x ¼ to 5-16	.20 "
1 to 1¾ x ¼ to 5-16	.30 "
¼ to 15-16 x ¼ to 5-16	.50 "
⅝ to 11-16 x ¼ to 5-16	.80 "
⅛ to 9-16 x ¼ to 5-16	1.00 "
⅛ to 7-16 x ¼ to 5-16	1.50 "

Heavy bands, 7-32 in. thick 1-10 c. per lb. higher than ¼ to 5-16 thick. **Bevel Edge Shaft Iron** 1-10 higher than same size of Heavy Bands.

Light Band Iron.

7 to 8 x No. 9 to 3-16	.90 extra
7 to 8 x Nos. 10, 11 and 12	1.00 "
6¼ to 6¾ x No. 9 to 3-16	.70 "
6¼ to 6¾ x Nos. 10, 11 and 12	.80 "
4¼ to 6 x No. 9 to 3-16	.50 "
4¼ to 6 x Nos. 10, 11 and 12	.60 "
1½ to 4 x No. 9 to 3-16	.40 "
1½ to 4 x Nos. 10, 11 and 12	.50 "
1 to 1 3-16 x No. 9 to 3-16	.50 "
1 to 1 3-16 x Nos. 10, 11 and 12	.60 "
13-16 to ⅞ x No. 9 to 3-16	.60 "
13-16 to ⅞ x Nos. 10, 11 and 12	.70 "
11-16 to ¾ x No. 9 to 3-16	.80 "
11-16 to ¾ x Nos. 10, 11 and 12	.90 "
9-16 to ⅝ x No. 9 to 3-16	1.00 "
9-16 to ⅝ x Nos. 10, 11 and 12	1.10 "
7-16 to ½ x No. 9 to 3-16	1.30 "
7-16 to ½ x Nos. 10, 11 and 12	1.40 "
⅜ x No. 9 to 3-16	1.50 "
⅜ x Nos. 10, 11 and 12	1.60 "

Bevel Edge Box Iron.

Same as Light Bands, of same sizes.

Beaded Band Iron, 1¼ in. to 2 in. 40

Sand Band Iron, 1-10 c. above same sizes of Light Bands.

Oval Iron.

⅛ to 1⅜	.40 extra.
¾ to 13-16	.50 "
⅝ to 11-16	.60 "
½ to 9-16	.80 "
⅜ to 7-16	1.10 "
½ to 9-16 x 3-16	1.00 "
⅝ to 11-16 x ⅛	1.20 "

Half Oval and Half Round.

2¼ to 3	.60 extra.
⅞ to 2	.50 "
¾ to 13-16	.70 "
⅝ to 11-16	.90 "
½ to 9-16	1.20 "
⅜ to 7-16	2.50 "
5-16	3.50 "
¼	4.50 "

Half Ovals less than ¼ their width in thickness, extra price.

Horse Shoe Iron.

All sizes 1 c. extra.

Cutting ordinary bars to specified length, .20 to .30 extra, according to length and size.

Steel Bands.

Width In Inches.	English Standard Gauge.	
1 1-2 to 6,	Nos. 7, 8, 9 or 3-16"	1.50 Base.
		Extras.
1½ to 6,	" 10, 11, 12 or ¼"	.05 per 100 lbs.
1 to 1¾,	" 7, 8, 9 or 3-16"	.10 "
1 to 1¾,	" 10, 11, 12 or ¼"	.15 "
13-16 and ⅞,	" 7, 8, 9 or 3-16"	.20 "
13-16 and ⅞,	" 10, 11, 12 or ¼"	.25 "
11-16 and ¾,	" 7, 8, 9 or 3-16"	.30 "
11-16 and ¾,	" 10, 11, 12 or ¼"	.35 "
9-16 and ⅝,	" 7, 8, 9 or 3-16"	.40 "
9-16 and ⅝,	" 10, 11, 12 or ¼"	.45 "
½, Nos. 7, 8, 9 or 3-16"		.55 "
½, " 10, 11, 12 or ¼"		.60 "
7-16 " 7, 8, 9 or 3-16"		.75 "
7-19 " 10, 11, 12 or ¼"		.85 "
⅜, " 7, 8, 9 or 3-16"		.95 "
⅜, " 10, 11, 12 or ¼"		1.05 "

Iron and Steel Hoops.

Width in Inches.	English Standard Gauge.	
1 7-16 to 3	Nos. 13, 14, 15 and 16	1.60 Base
		Extras
1 7-16 to 2,	" 17, 18, and 19	.05 per 100 lbs.
1 7-16 to 2,	" 20	.10 "
1 7-16 to 2,	" 21	.15 "
1 7-16 to 1¾,	" 22	.25 "
1 ⅛ to 1¾,	" 13, 14 and 15	.05 "
1⅛ to 1¾	" 16,17 and 18	.10 "

R. D. NUTTALL CO.,

99 BOQUET STREET, ALLEGHENY, PA.

ROLLING MILL,

BRIDGE, MINING,

HEAVY DUTY

GEARS AND PINIONS.

This is 4-inch Circular Pitch.

We Cut Involute, Epicycloidal or Special Teeth.

Spur, Bevel or Spiral Gears. Racks, Quadrants and Worm Gearing.

EVERYONE BUT REPAIRMEN IS ENTHUSIASTIC OVER THE 1897.

Windsor BICYCLES

STRICTLY HIGH GRADE.

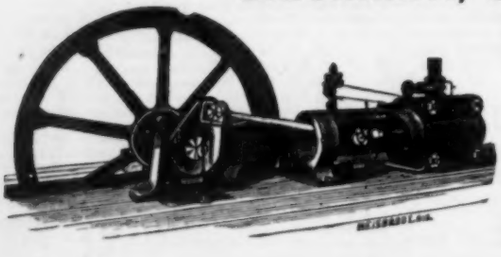
The only wheel in the world fitted with watch-case dust caps over all bearings. Adds 50 per cent to the life of a wheel.

MADE BY Chas. H. Sieg Mfg. Co KENOSHA WIS.

-CHICAGO OFFICE and SALESROOM, 285 Wabash Ave.

THE LANE & BODLEY CO.,

CINCINNATI, OHIO.



Engines,

ALL SIZES.

Simple and Compound.

Shafting, Hangers, Pulleys.

Belt Elevators, Saw Mills.

1¼ to 1⅜,	"	19 and 20	.15 per 100 lbs
1⅛ to 1⅜,	"	21	.20 "
1¼ to 1⅜,	"	22	.30 "
15-16 and 1,	"	13, 14 and 15	.10 "
15-16 and 1,	"	16, 17 and 18	.15 "
15-16 and 1,	"	19 and 20	.20 "
15-16 and 1,	"	21	.25 "
15-16 and 1,	"	22	.35 "
⅞,	Nos.	13, 14 and 15	.20 "
⅞,	"	16, 17 and 18	.25 "
⅞,	"	19 and 20	.30 "
⅞,	"	21	.35 "
⅞,	"	22	.45 "
¼ and 13-16	Nos.	13, 14 and 15	.30 "
¼ and 13-16	"	16, 17 and 18	.35 "
¼ and 13-16	"	19 and 20	.40 "
¼ and 13-16	"	21	.45 "
¼ and 13-16	"	22	.50 "
¼ and 13-16	"	23	.60 "
11-16,	Nos.	13, 14 and 15	.35 "
11-16,	"	16, 17 and 18	.40 "
11-16,	"	19 and 20	.50 "
11-16,	"	21	.60 "
11-16,	"	22	.70 "
11-16,	"	23	.80 "
⅝,	Nos.	13, 14 and 15	.40 "
⅝,	"	16, 17 and 18	.45 "
⅝,	"	19 and 20	.55 "
⅝,	"	21	.65 "
⅝,	"	22	.75 "
⅝,	"	23	.85 "
9-16,	"	13, 14 and 15	.45 "
9-16,	"	16, 17 and 18	.50 "
9-16,	"	19 and 20	.60 "
9-16,	"	21	.70 "
9-16,	"	22	.80 "
9-16,	"	23	.90 "
½,	"	13, 14 and 15	.55 "
½,	"	16, 17 and 18	.60 "
½,	"	19 and 20	.70 "
½,	"	21	.80 "
½,	"	22	.90 "
½,	"	23	1.00 "
7-16,	"	13, 14 and 15	.80 "
7-16,	"	16, 17 and 18	.90 "
7-16,	"	19 and 20	1.00 "
3⅜,	"	13, 14 and 15	1.00 "
3⅜,	"	16, 17 and 18	1.10 "
3⅜,	"	19 and 20	1.20 "

Sheet Iron.

No. 10	1 50
No. 12	1 70
No. 14	1 60
No. 15-17	1 75
No. 18	1 85
No. 20	2 00
No. 22-24	2
No. 25-26	2 20
No. 27	2 30

English Tool Steel.

Jessop's	15½c
Hobson's "Best"	15½c
" "Choice"	35c

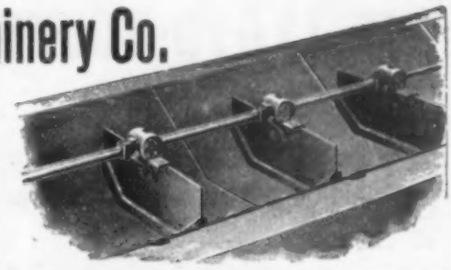
The Link-Belt Machinery Co.

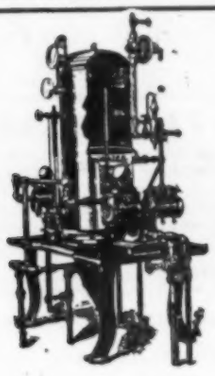
ENGINEERS. FOUNDERS. MACHINISTS.

CHICAGO, U. S. A.

Modern Methods as applied to the handling of Iron Ore, Coal, Raw and Manufactured Products.

Manila Rope, Power Transmissions, Shafting, Pulleys, Shaft Bearings, Gearing Friction Clutches, etc.





IMPROVED DUPLEX SYSTEM

- - - FOR - - -

BURNING FUEL OIL.

Heats and cleans the oil and delivers it to the fires under high and uniform pressure.

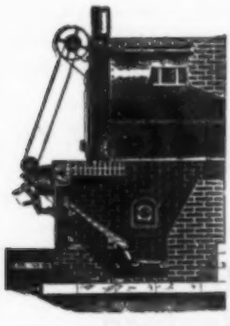
Entirely automatic, most scientific, sensible and economical method of burning oil in existence. If you are operating a Steel Works, Brass or Copper Rolling Mill, Malleable Iron Works, Bolt and Nut Works, Bicycle Works, or do Annealing, Forging, Brazing, Tempering, Japanning, Enameling, Case Hardening, you can use this machine to your advantage.

WE BUILD FURNACES OF ALL KINDS. SATISFACTION GUARANTEED.

W. S. ROCKWELL & CO.,

26 CORTLANDT STREET, NEW YORK.

H. H. CAMPBELL.



Brightman Furnace Co.

648 Broadway, CLEVELAND, O.

SOLE MANUFACTURERS OF THE

Brightman Mechanical Stoker

FOR STEAM BOILERS.

THE MOST ECONOMICAL IN FUEL

and the Best Device in the World for Preventing Smoke.

Send for Catalogue "A."

STUART FIRE BRICK CO.

MANUFACTURERS OF

Silica Brick

For Open-Hearth, Basic and Acid Steel Furnaces, Glass and Copper Tank Furnaces. Extra Shapes MADE TO ORDER.

Office, Room 21, Conestoga Bldg., Cor. Wood and Water Sts., PITTSBURG, PA.

The Chicago & North-Western Railway

REACHING with its 7,966 miles of road the famous Water Powers, Coal Fields, Iron Ore Ranges, Hard and and Soft Lumber Districts located in Illinois, Wisconsin, Michigan, Iowa, Minnesota, South Dakota, North Dakota, Nebraska and Wyoming, and by traffic arrangements with other railways, 7,350 stations located on 41,000 miles of railroad (one-ninth of the entire railroad mileage of the world, and one-fourth of the railroad mileage of the United States), has on its line more industries than any other western railroad.

Manufacturers contemplating moving or establishing branch factories in the West are requested to inquire what we can offer them before locating elsewhere.

M. HUGHITT,
General Freight Agent,
CHICAGO.

Steel Boiler Plates—1-4 in. and Heavier.

Tank	1 35
Shell	1 45
Flange	1 55
Marine Flange	1 60
Fire Box	2 05

Above includes plates 90 inches wide.

90 to 96 in. wide	½c. lb. extra
96 to 100 in. wide	1c. "
100 to 104 in. wide	1½c. "
104 to 106 in. wide	special.

Flats. cts. lbs.

2 to 9-16 in. wide by 2 to ⅝ thick .08

Bessemer and O. H. Steel.

Bessemer Machinery	base price,	1 40
Open-hearth Tire	"	1 45
Open-hearth Spring	"	1 80
Sleigh Shoe	"	1 45
Toe Calk	"	1 90
Cutter Shoes, tapered and bent	"	1 60

American Cast Tool Steel.

ROUND, SQUARE, AND OCTAGON.	cts. lbs.
1 to 2 in. inclusive	08
9-16 to ⅝ in. "	08
7-16 to ⅜ and 2⅝ to 3 in.	09
3⅛ to 4 in.	09⅛
⅝ to 11-16 and 4⅛	10
⅛ to 6 in.	10⅛
¼ to 9-32 and 6⅛ to 7 in	11
1 in.	13

Burden Boiler Rivets.

½, ⅝, 11-16 and ¾ inches diameter	3 00
Bridge ½, ⅝, 11-16 and ¾ inch diam	2 55

Wrought Pipe and Boiler Tubes.

Lap weld black, base, four 10s	62
Butt " " " four 10s	62½
Lap " galv. " four 10s	52½
Butt " " " four 10s	50
Boiler tubes 2¼" and smaller	70
Boiler tubes 2½" and larger	75
Casting screw and socket joint	dis. 52½
Casing inserted joint	dis. 47½

MACHINERY SUPPLY MARKET.

[From Store, Cleveland.]

Anti-Friction Metals.

Magnolia Anti Friction Metal, 25 cts. per lb., f. o. b. New York or Chicago.

No Name Metal, 18 cts. per lb., f. o. b. New York or Chicago.

Mystic Metal. 8 cts. per lb., f. o. b. New York or Chicago.

Anvils.

American	₩ lb 9@10
Wright's	₩ lb 12

Bellows.

Blacksmiths'	Hill's	dis 40
	Bullock's	dis 50&10
Moulders'		dis 40@40&10
Hand		dis 40&10@50

Belting.

Boston Belting Co.'s standard	dis 10 & 10
" " " extra	dis 60&10
" " " best	dis 55
Cleveland Rubber Co. extra standard	dis 60&10
Hoyt's Short Lap	dis 50
Shultz Raw Hide Leather Belting, single	dis 40
Munson's Short Lap Single Leather	dis 50
Munson's Short Lap Double and Light Double Leather	dis 50&10
Shultz Raw Hide Leather Belting, Double and Light Double	dis 40
Standard, oak tanned	dis 50&10
Alexander Brothers' pure oak tanned	dis

Blowers and Exhausters.

B. F. Sturtevant's	dis 20
Boston Blower Co.	dis 35

Chucks.

Cushman's 4 Jaw Independent	dis 45
" Combination	dis 40
" Geared Scroll	dis 80
" 3 Jaw Brass Workers	dis 30
" Drill	dis 35
Wescott's Scroll Combination	dis 33⅓
" Independent	dis 40
" Little Giant Drill	dis 33⅓
Horton's Independent	dis 45
Whiton's Independent	dis 45
National Combination	dis 45
Sweetland "	dis 40
Almond Drill	dis 40
Morse "	dis 20
Skinner's Combination Lathe	dis 40&15
" Independent Lathe	dis 40&10
" Universal Lathe	dis 40&10
" Drill	dis 30

Cutters and Reamers.

Cleveland	dis 10@15
Pratt & Whitney	dis 10@15
Standard	dis 10@15
Morse	dis 10 to 15
Brown & Sharpe, Milling Cutters	dis 15
" " Gear Cutters	dis 15

Crowbars.

Cast Steel	₩ 3½
Iron, steel points	₩ lb 3

Drill and Drill Sockets.

Twist Drills	
Morse Taper&Straight Shank to 1¼"	dis 50 &10 to 60
Morse Taper and Straight Shank Larger than 1¾"	dis 25
Drill Sockets	dis 25
Standard Twist Drills	dis 60@60&5
Cleveland " "	dis 60@60&5

Emery.

	No. 4 to No. 54 46 gr.	150 gr.	Flour, F. F
Kegs, ℔ lb	4½c	5 c	2½c
½ kegs ℔ lb	4¾c	5¼c	2¾c
¼ kegs ℔ lb	5 c	5½c	3 c
10 lb cans, 10 in case	6 c	6½c	5 c
10 lb cans less than 10	10 c	10 c	½c

Emery Cloth and Paper.

Barder, Adamson & Co. ..... dis 50@50&5
H. H. Barton ..... dis 50@50&5

Emery Wheels.

Detroit ..... dis 60@70
Norton's ..... dis 60@70
Cvant ..... dis 60@70
Sterling ..... dis 60@70
Celluloid ..... dis 10&33⅓
Northampton ..... dis 50
Crystal ..... dis 65@70
Vitrified ..... dis 60@70
Vulcanite ..... dis 60&10
Hamden ..... dis 60&10@70
Cyclone ..... dis 60@60&10

Files.

Arcade ..... dis 60&10@60&10&10
Nicholson ..... dis 60&10@60&10&10
" X. F. ..... dis 25
Kearney & Foot ..... dis 60&10@60&10&10
Black Diamond ..... dis 60&10@60&10&10
McClellan ..... dis 60&10@60&10&10
Disston's ..... dis 65@70
Western ..... dis 70
Stub's ..... dis 25
Grobet's ..... dis 30
Reynolds Bros.' Hand Cut ..... dis 50
Industry File Works Hand Cut ..... dis 50

Hammers.

P. S. W ..... dis 40
Atha new list, Jan. 15, 1897 ..... dis 50
Heavy hammers and sledges under 5 lbs 10c
" " " " over 5 lbs 8c

Jack Screws.

Illinois Bolt Co. list ..... dis 75

Nuts and Washers.

Size of bolt inches	¼	5-16	⅜	½	⅝	¾	⅞	1
Square	8	7	5½	4½	4	3½	3⅛	
Hexagon	15½	11½	8½	6	5½	5	4½	
Washers	9	8	7	5	4½	4½	4⅛	4⅛

In lots less than 100 lbs, ℔ lb add ¼c., 1 lb boxes add 1c to list.

Nails (wire).

Standard Penny Nails, ℔ keg, base.
Car lots $1.35
Less than car lots $1.45

Oilers.

Zinc and Tin ..... dis 60
Brass and Copper ..... dis 50
Malleable (Hammer's), No. 1, $3.60; No. 2, $4.00; No. 3, $4.40 ℔ doz ..... dis 10@10&10

Rivets.

Iron, Thousand, list November 1, 1894 ..... dis 60@65
Iron, Ordinary, Cooper's Block and Carriage list November 1, 1894 ..... dis 60@65
Copper ..... dis 50@50&10

Taps.

Cards, Hand and Nut to 2 in. ..... dis 50
Carpenters' " " " ..... dis 50
Morse " " " ..... dis 50
Pratt & Whitney " " new list ..... dis 10
Machine Screw Taps ..... dis 55
Pipe Taps to 2½ in ..... dis 70
Stay Bolt Taps ..... dis 25
Stove Bolt Taps ..... dis 55
Pulley Taps ..... dis 40

Vises.

Solid Box ..... dis 60
Parker's ..... dis 20@25
Prentiss ..... dis 20
Stephen's ..... dis 25@35
Barrett's ..... dis 30
Miller's Falls ..... dis 40
Merrill's ..... dis 15@20
Howard ..... dis 35

Wire.

New List, Apr. 9, 1894

Brass ..... dis 35c
Copper ..... dis 35c
Bright and annealed, Nos. 0@18 ..... dis 70&10&75
" " Nos. 19@26 ..... dis 75@75&5
" " Nos. 27@36 ..... dis 75&10&5
Coppered Nos. 0 to 18, market list ..... dis 70@70&5
Galvanized Nos. 0 to 18 " " ..... dis65&5
Tinned market Nos. 0 to 18 ..... dis 67½
Cast steel ..... dis 50
Tinned Broom Wire ..... dis 70&5@70&10
Annealed Fence, Nos. 8 and 9 ..... dis 75
Annealed Grape, Nos. 10 to 14 ..... dis 75
Stub's Steel Wire regular ..... 05c ℔ lb dis 30

SHIFFLER BRIDGE COMPANY,

BUILDING DEPARTMENT.

SPECIALTIES: Steel and Iron Buildings for Rolling Mills, Tin Plate Plants, Steel Works, Foundries, Factories, Roof Trusses, Girders, Columns, Beams, Corrugated Iron, Etc.

Main Office and Works:

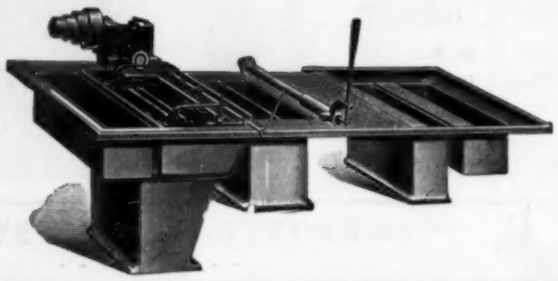
48th Street and A. V. Ry., PITTSBURG, PA

Branch Offices:

1123 Betz Building, Philadelphia, Pa.
45 Broadway, New York, N. Y.
228 Lumber Exchange, Minneapolis, Minn.
1243 Marquette Building, Chicago, Ill.

THE LLOYD-BOOTH CO., YOUNGSTOWN, OHIO.

Tinning MACHINERY



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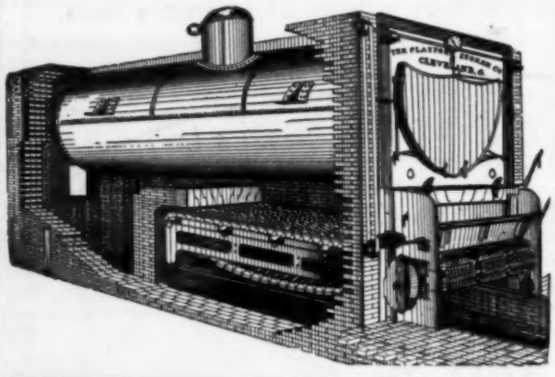

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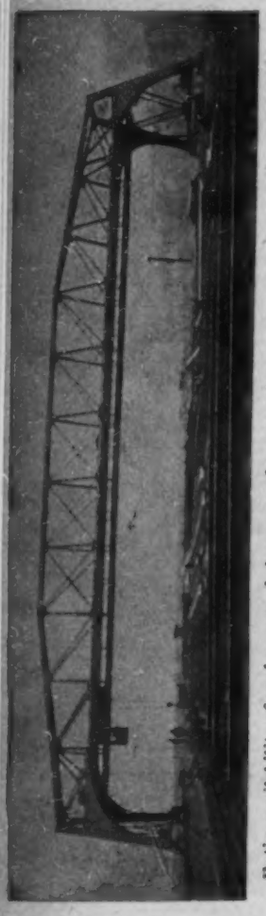

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Write us for further description. We can build these cranes in whatever size and capacity may best suit your purpose.

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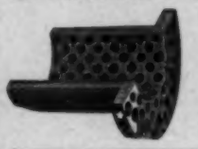

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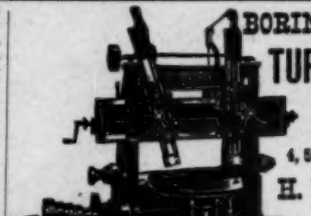

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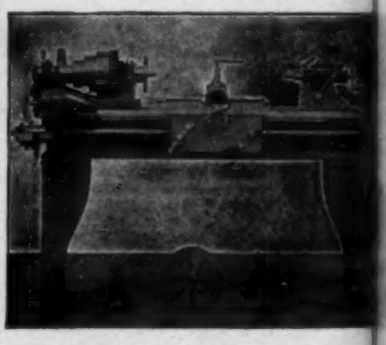

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